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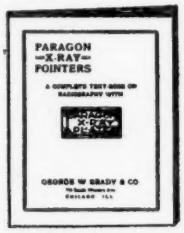

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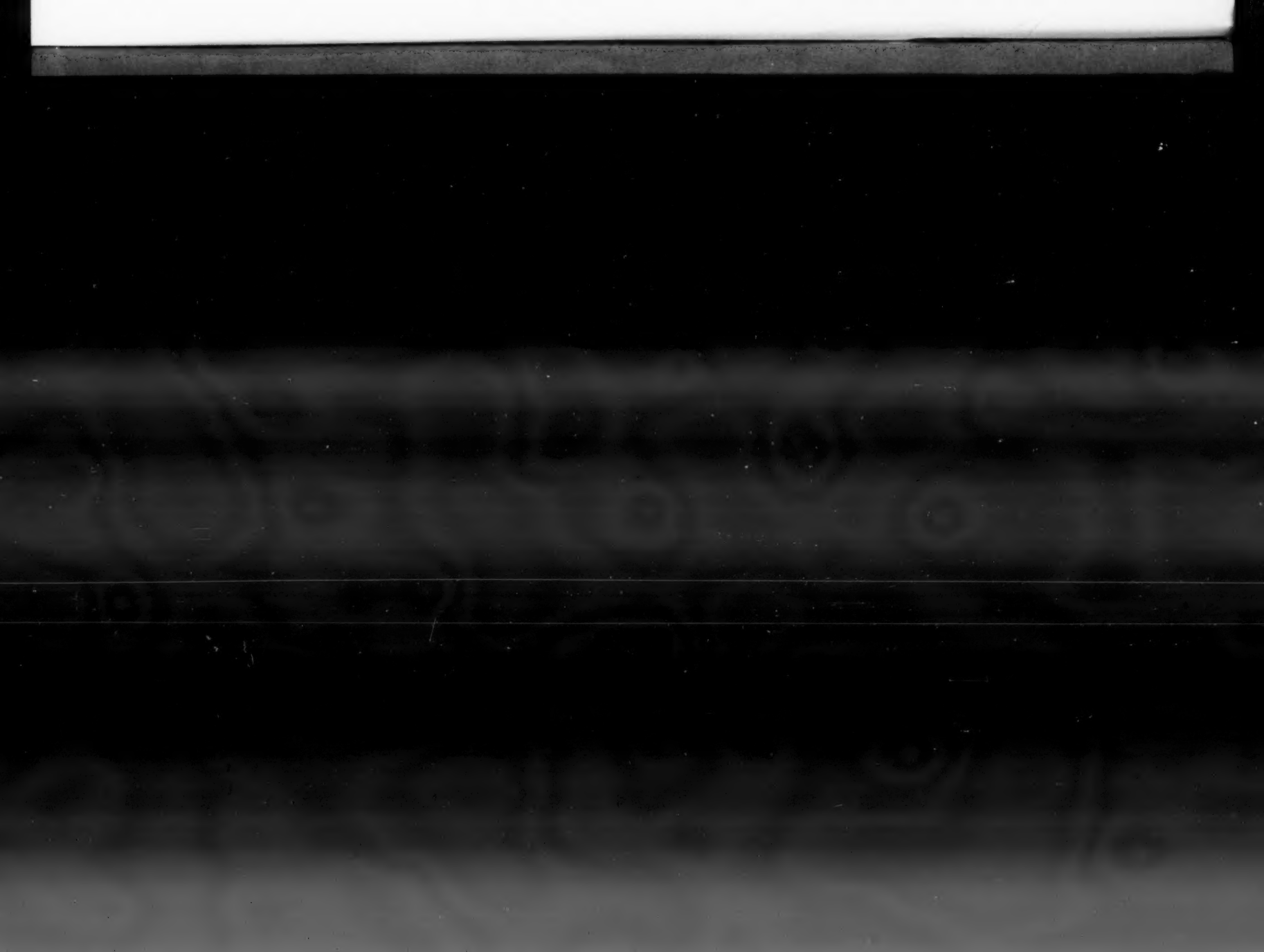


SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXII MARCH, 1916 NUMBER 3

THE OPERATIVE TREATMENT OF PYLORIC OBSTRUCTION IN INFANTS

WITH A REVIEW OF SIXTY-SIX PERSONAL CASES[1]

BY WILLIAM A. DOWNES, M.D., F.A.C.S, NEW YORK

IN April, 1914, the writer reported the operative results obtained in 22 cases of pyloric obstruction in infants. At that time the symptoms of the disease were given as were measures necessary to establish the diagnosis, and reasons were stated which seemed sufficient to justify the opinion that surgical intervention was indicated in every case in which definite obstruction was present or seemed imminent.

Since that report was made, 44 additional cases of this disease have come under my care, making a total of 66 cases, observed in five and one-half years. This added experience has in many ways been a source of much gratification, but has not been without its disappointments. To begin with it has not enabled us to add anything new to the etiology or pathology of the disease, notwithstanding the fact that partial or complete necropsy was obtained in every case dying in the hospital.

With one exception there was the characteristic tumor at the pylorus. All showed marked hypertrophy of the band of circular muscle fibers with the redundant and thickened mucous membrane lying in longitudinal folds. The tumor in the single exception noted above while of considerable size was less firm, and the incised muscle not more than half as thick as in the average case. These differences were noted, but were not properly interpreted. The baby continued to vomit after operation and died in 18 hours. At necropsy, Dr. Martha Wollstein, Pathologist to the Babies' Hospital, discovered a small tumor, originating in the muscularis mucosa, projecting into and filling the lumen of the pylorus (Figs. 1 and 2).

Most of the stomachs were of an average size, a few very large and two or three very small; one was so small that it would hold only 1 ounce. Œdema in varying degrees involving the pylorus and pyloric region of the stomach was present in all cases, and in a few instances it was present throughout the stomach wall. We believe the presence of this œdema plays a very important rôle and is the factor which determines the definite onset of symptoms.

The theory that best explains the sequence of events in this disease is that a true malformation is present at birth consisting of an abnormal thickening of the circular muscle of the pylorus, and that the effort necessary to force food through the narrowed and elongated pyloric lumen produces circulatory disturbance resulting in œdema. As the food is increased in amount and the muscular effort becomes greater the lumen narrows down until

[1] Read before The Southern Surgical and Gynecological Association, Cincinnati, December 13–15, 1915.

finally at the tenth day or a little later it becomes more or less completely obstructed. In support of this theory I would call attention to the fact that, after the symptoms have developed, a reduction in the amount of food with consequent relief of muscular effort, together with systematic stomach washing which removes curds and mucus, will often give temporary relief and in an exceptional case if the muscular hypertrophy is not too extensive carry the child along for a time. However, as the food is again increased all the symptoms recur.

In Case 7, typical symptoms began at 5 weeks, which under careful feeding and lavage subsided in a few days, and the child began to gain; 3 weeks later, however, after increased feedings, there was a recurrence with sudden marked depression requiring immediate operation.

As shown by Holt, definite persistent pyloric spasm without hypertrophy has yet to be proved. This author prefers to divide cases showing the symptom-complex under discussion into mild and severe types, and recommends that the term "pylorospasm" be discarded. Unquestionably, there is a definite element of spasm in these cases, but it is the result and not the cause of the hypertrophy.

SYMPTOMS

The group of symptoms which go to make the diagnosis is projectile vomiting, tumor, peristaltic waves, gastric retention and rapid loss of weight. Marked constipation is usually present, although a starvation stool or even one containing milk may occur from time to time, depending entirely upon the degree of obstruction. So much has already been said in reference to the symptoms and diagnostic signs, that I will take up but one, and that is the question of tumor.

In every case here reported the presence of a tumor, described as varying in size from the terminal phalanx of the little finger to that of the thumb was noted by at least two or more observers and so charted before operation. In a few instances where there was some doubt owing to difficulties in palpation, light anæsthesia (ethyl chloride inhalation) was required. This procedure is simple and the information of such value that any slight risk is more than offset. Before administering the anæsthetic a tube should be passed to the stomach. This removes the gas and makes it much easier to palpate the tumor which lies to the right and above the umbilicus. I consider the presence of this so-called tumor pathognomonic of the disease. The various house physicians at the Babies' Hospital, where most of the cases were observed, have expressed the same view. The diagnosis based upon this sign alone was frequently made by them in the admitting room.

Those who state that a tumor can be found in a small percentage of cases only, have either seen too few patients with this disease for their opinion to be of value, or else have failed to make a proper examination. That vomiting, loss of weight, retention, and all the symptoms of high obstruction in the alimentary canal may occur without a palpable tumor at the pylorus there is no doubt. One such case was operated upon at the Babies' Hospital, in which a heavy peritoneal band passed from a loop of the ileum across the hepatic flexure of the colon and was adherent to the duodenum in such a way as to cause complete obstruction (Fig. 3). Without operation or necropsy this case might have been recorded as one of pyloric obstruction in which no tumor existed.

OPERATIVE TREATMENT

Obstruction at the pylorus is just as definitely an obstruction of the intestinal tract as that situated at any other part of the canal. It belongs to the obturation type which is without strangulation and is therefore without the toxæmia of the more acute form. The sudden marked depression with collapse and death seen in the neglected cases is not toxic in character, but the result of starvation. With this knowledge of the disease it would seem that the rational treatment to adopt is that designed to relieve the cause of the obstruction at the earliest possible moment.

Until within recent years the operative results in pyloric obstruction were so uncertain that physicians did not feel justified

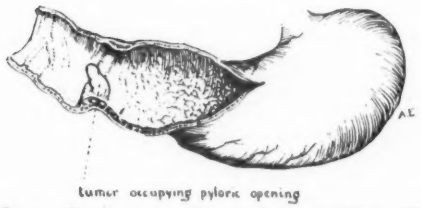


Fig. 1. Tumor occupying pyloric opening. (From sketch made at time of necropsy.)

Fig. 2. Cross section of tumor arising from muscularis mucosæ, shown in Figure 1.

in recommending surgical treatment. Now that the disease is better understood and the operative technique greatly improved these objections no longer hold. Under the most favorable conditions and in the best hands cases treated medically are long drawn out — 10 to 12 weeks or even longer — with the result always in doubt, and the knowledge ever present that without the slightest warning the baby may go into collapse and die, even though its progress had been favorable.

At the present time the opinion of most pediatricians with unbiased minds is almost a unit as to the necessity of operation in these cases once the diagnosis is established. In the cases seen and diagnosed early, some feel that a few days of careful observation with proper feeding and lavage, is justified with the hope that the symptoms may subside; others advise immediate operation in every case. All agree that most cases surviving operation make a rapid and satisfactory recovery.

A number of operative procedures have been resorted to in the surgical treatment of pyloric obstruction, only two of which, however, posterogastro-enterostomy and partial pyloroplasty, have given results sufficiently satisfactory to warrant adoption.

So far as I know the largest individual series of cases operated on heretofore reported have been those of Richter, Scudder, and myself. Posterogastro-enterostomy was the procedure adopted by each of us and the mortality rate was 14 per cent, 24 per cent, and 32 per cent respectively. The total number of cases in these 3 series was 61, with a mortality of 22 per cent. This was a much lower rate than any previously recorded for so large a number of cases. In my own hands, the mortality following gastro-enterostomy continued above 30 per cent. This was due in part to the critical condition of the infants at the time of admission to the hospital. Operation was refused in no case, but there were a number of deaths which could not be attributed wholly to the condition of the babies. It was the effort to avoid seemingly uncontrollable fatal complications which occurred late in the convalescence of these babies that caused us to give up gastro-enterostomy, at least for the time being. Therefore, in October, 1914, we decided to give the so-called partial pyloroplasty of Rammstedt a thorough trial, and our results have been more satisfactory since that date. Of the 66 infants included in this report 31 had a gastro-enterostomy done, and 35 were operated on according to the method of Rammstedt (Figs. 4 and 5). The operation in 19 of those done by the latter method was modified to the extent of passing a sound through the pylorus after the muscle had been divided. The sound was introduced through a small incision made in the stomach wall some distance from the pylorus. This procedure is similar to that recommended by Keefe, with the exception, that the sound is passed after the circular muscle is divided and not before (Fig. 6).

The gastro-enterostomies were done according to the posterior no-loop method,

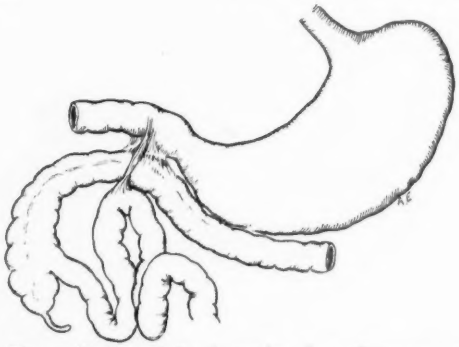


Fig. 3. Peritoneal band passing from ileum across hepatic flexure and adherent to duodenum causing obstruction.

Fig. 4. First step of Rammstedt operation. Tumor supported. Line of incision shown.

with the exception of the first 2 cases where clamps were not used. The duration of operation varied from 25 to 45 minutes. The partial pyloroplasty or "nicking of the circular muscle fibers" consisted in making a longitudinal incision from 2 to 3 cm. in length through the serosa and the hypertrophied circular muscle fibers of the pylorus down to the thickened mucosa. Duration of operation 10 to 20 minutes. In performing this operation the pyloric tumor should be held firmly between the thumb and index finger, and as the incision is deepened the edges of the wound gently forced apart. After the muscle is cut through, a definite line of cleavage is seen to exist between the muscle and the mucous membrane. A small pair of blunt pointed, curved scissors may be used to advantage in spreading the incision. When the muscle is sufficiently divided the liberated mucous membrane protrudes freely into the wound. There is very little hæmorrhage — occasionally a small vessel may require a ligature — but as a rule the application of hot pads to the edges of the wound for a few minutes controls the bleeding. This completes the operation. The tumor is dropped back into the abdomen and the wound is closed.

In spreading the incision and separating the muscle from the mucous membrane it is best to start from the stomach end of the incision, as here the merging of stomach wall into pyloric tumor is a gradual one, and there is not much danger of opening the mucous membrane, whereas, the change from the thickened and œdematous pylorus to normal duodenum is so sudden that extreme care is necessary, in order to avoid opening the intestine at this point. On account of this accident some operators have discarded this operation and have returned to gastro-enterostomy. It occurred twice early in our series, but fortunately the openings were small and very easily closed and no bad effect followed. It is not necessary to cover the incision at the pylorus with omentum, or to attempt its closure with flaps from the muscle, nor should the effort be made to close the wound by converting the longitudinal into a transverse incision. It is very difficult to get sutures to hold in this tissue, and besides there is risk of again narrowing the lumen. The fact that the mucous membrane did not give way in one of our 35 cases is sufficient proof that any effort to reinforce the wound is unnecessary.

For fear that simple division of the hypertrophied circular muscle-fibers did not quite meet all the indications in these cases, I decided to modify the operation as already stated. This was done 19 times, and in every case a No. 20 sound (French scale) was passed through the pylorus without the slightest resistance. The cases in which this modification of the Rammstedt operation was done did no better than those operated on by the simpler method, and it was soon discarded, not, however, until one and possibly two fatalities resulted from its use. At

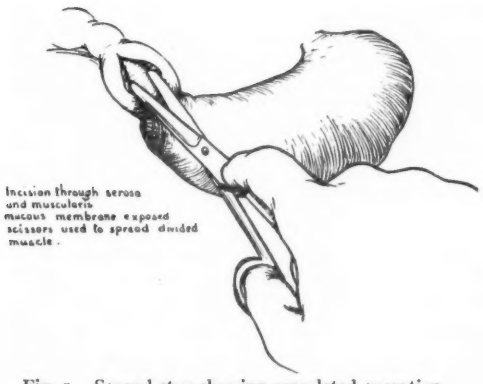


Fig. 5. Second step showing completed operation.

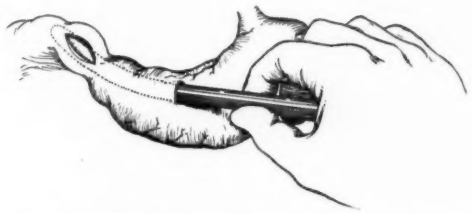


Fig. 6. Modified Rammstedt operation. Sound passed through pylorus after circular muscle has been divided. (This modification has been discontinued.)

times it was very difficult in the small thick-walled stomachs to properly close the incision made for the passage of the sound. In one instance a stitch gave way and the baby died of peritonitis. A second case of peritonitis occurred where this method was used, and it is very likely the infection resulted from the incision into the stomach although no leakage could be discovered at necropsy.

RESULTS

The general condition of the babies subjected to the two operative procedures — gastro-enterostomy and partial pyloroplasty — averaged much the same. Several in each group were almost moribund at the time of operation. The stimulating effect of ether and the value of hypodermoclysis is well shown in these cases as most of them were in as good condition at the close of the operation as they had been at the beginning. All cases survived the immediate effect of operation, the earliest death occurring in 3 hours. The smallest baby in the entire series weighed 3 pounds 15 ounces; the largest 9 pounds 9 ounces; average weight 6 pounds 8 ounces. The smallest baby recovering after gastro-enterostomy weighed 5 pounds, and after the Rammstedt operation 4 pounds. The average age for the series was 6 weeks, youngest 3 weeks, oldest 20 weeks. Of the 31 cases in which gastro-enterostomy was performed, 11 died, giving a mortality of 35 per cent; 2 died as a direct result of faulty technique; 3 died in a few hours, and 6 died in from 5 to 19 days after operation. Of the 20 cases discharged as cured 2 died within a short time from acute gastro-enteritis, and 1 died in 3 months from diphtheria. The remaining 17 cases are alive at the present time, all are well and have developed normally in every way.

So far as I can find out no late complications have followed the gastro-enterostomy. Roentgen-ray examination of several of the cases from one to three years after operation shows that the stomata are working satisfactorily and that little or no bismuth passes the pylorus, thus proving that the obstruction is permanent and that it is not influenced by this type of operation. The latter observation is also borne out by the fact that at necropsy in the case dying 3 months after operation the tumor was unchanged. It is only fair to say that the 3 cases dying shortly after operation were in extremis, and it is doubtful if the final result was influenced to any appreciable degree by the operation. It is to the group of 6 cases dying from 5 to 19 days after operation that I wish to call special attention: 1 died on the fifth day of acute nephritis; 3 cases continued to vomit moderately for a few days, gradually growing worse until death which took place on the sixth, fifteenth, and nineteenth days. The case dying on the fifteenth day was re-operated on shortly before it died, but no cause for the continued vomiting could be found. Necropsy in the other 2 cases likewise failed to explain the persistence of the symptoms. The two remaining cases developed diarrhœa, became depressed, and in spite of every effort died in from 10 to 12 days. In none of these cases did post-mortem

examination show peritonitis or in any way explain the fatal result with the exception of the one case dying of nephritis. The anastomoses were properly located, had healed, but in 3 cases failed to functionate as they should. It is on account of this unfortunate experience which is without satisfactory explanation that we decided to try other measures for the relief of pyloric obstruction.

Of the 35 partial pyloroplasties, 1 was done in April, 1914, and has been previously reported; 1 was operated upon the following May; and the rest since October, 1914. Eight deaths occurred in this series, a mortality of 23 per cent. Two died of peritonitis following the modified operation as already mentioned. One died 20 hours after operation with symptoms unrelieved, and necropsy showed a small tumor arising from the muscularis mucosa completely blocking the pylorus. Four cases died in from 4 to 27 hours — all were practically moribund and the result was to be expected. One died of inanition on the twenty-sixth day; when this baby was given more than 1 ounce of food it would vomit. The smallest and thickest walled stomach yet observed by us was found at necropsy in this case. The pylorus was patent. There were discharged as cured 27 cases. Of these 1 died in a convulsion some 10 days after leaving the hospital; up to a few hours before death its condition had been excellent. Post-mortem examination not obtained. One case returned to the hospital 3 months after operation suffering from endocarditis and pericarditis from which it died. The stomach removed at necropsy showed an elliptical cicatrix on the anterior surface of the pylorus about one-half the size of the original wound. This area was covered with serosa and appeared to be composed of serous and mucous coats only. The remaining portion of the pylorus was somewhat thicker than normal, but the tumor which had been "a typical one of moderate size" had almost entirely disappeared.

The other 25 cases have been kept under close observation and are in good condition. They have all gained rapidly and many of them are above their normal weight; in no case has there been a return of the symptoms. Roentgen examination has been made of 4 cases from 6 months to 1 year six months after operation, and the stomachs have much the same appearance as those of other babies. They empty more slowly than the gastro-enterostomy cases, but at about the normal rate.

POST-OPERATIVE TREATMENT

The cases operated on by the method of Rammstedt required less stimulation and reacted more quickly than those in which gastro-enterostomy was done. Vomiting was less frequent and smaller in amounts than after the latter procedure. All cases surviving partial pyloroplasty began to improve rapidly after the second or third day, some had setbacks and a few were difficult feeding cases, but as a rule they were much less trouble to feed than the gastro-enterostomies. A number of the latter developed a diarrhœa in from a week to 10 days, which was difficult to control and in 2 instances proved fatal. The pyloroplastic cases did not show this tendency and I believe the explanation lies in the fact that the food passing out of the stomach through the natural channel at a normal rate has less tendency to cause intestinal disturbance than when it passes through the artificial opening at a rate which in many instances, as shown by X-ray, is much too rapid.

Feeding is begun in the Rammstedt cases in about 2 hours; 2 to 3 drams of breast milk, alternating with water, is given every 2 hours to start with, and this is rapidly increased so they are getting from 1 to 1.5 ounces every 3 hours at the end of the second day. The gastro-enterostomy cases required more care in their feeding and tolerated the rapid increase in amount less well than did the other class of cases.

CONCLUSION

I have gone somewhat into detail in comparing the results obtained in the use of gastro-enterostomy and partial pyloroplasty in the treatment of pyloric obstruction, in order to bring out the advantages as well as the disadvantages of each method. From the foregoing it seems fair to say that partial pyloroplasty has many advantages over gastro-enterostomy. The time required

to do the former operation is less than half that required to perform the latter, reaction is more prompt, feeding is begun earlier and can be pushed more rapidly, post-operative vomiting is less and late complications such as diarrhœa and unexplained vomiting do not occur.

The operation is simple, requires much less surgical skill than gastro-enterostomy, and most important of all the obstruction is permanently removed and the normal continuity of the alimentary tract is preserved. Specimen removed from the case dying 3 months after operation and roentgen examination one and one-half years after operation prove the accuracy of this statement.

The method is open to the criticism that it leaves an uncovered wound, that the abdominal cavity is protected from contamination only by a thin layer of mucous membrane, and that as the scar contracts the obstruction will reform. I believe the excellent results obtained by other surgeons using this method together with those here recorded prove these criticisms to be largely theoretical. The danger of opening the mucous membrane is a real one, but with care should be avoided. To the above objections may be added the fact that in our unique case of tumor blocking the pyloric lumen this type of operation was inadequate. If a little more care had been exercised in examining the pylorus in this case the cause of obstruction would probably have been discovered. It is needless to say that a gastro-enterostomy should be added if in any case there is reason to suspect that the lumen of the pylorus does not become patent after division of the circular muscle.

Continued experience and longer observation of the cases may bring out other more serious objections to partial pyloroplasty; but until that time, or until something better is proposed, operation according to the method of Rammstedt should be the one of choice in the treatment of pyloric obstruction in infants.

Finally, the success or failure of either operative procedure is determined in a large measure by the length of time lapsing between the onset of symptoms and the time of operation.

ADENOMYOMA OF THE ROUND LIGAMENT AND INCARCERATED OMENTUM IN AN INGUINAL HERNIA, TOGETHER FORMING ONE TUMOR[1]

By THOMAS S. CULLEN, M.B., F.A.C.S., Baltimore, Maryland

FOR many years isolated cases of adenomyoma of the uterus have been recorded, but it was not until the epoch-making monograph on the subject published by von Recklinghausen that we were given a thoroughly comprehensive picture of this condition. In March, 1895, I reported my first case of adenomyoma of the uterus, before the Johns Hopkins Medical Society; since then I have been much interested in adenomyomata.[2]

In 1896 it fell to my lot to record the first case of adenomyoma of the round ligament. At this time I sent Professor von Recklinghausen a slide from the round-ligament tumor and when writing me a short time later he said that he had shown my section before the Naturforscher Versammlung at their Frankfurt meeting. Since that time quite a number of adenomyomata of the round ligament have been detected.

When analyzing the umbilical tumors recorded in the literature I encountered quite a number that had been variously diagnosed. These tumors were found only in women, tended to swell at the menstrual period, and occasionally discharged a little blood at the period. On section some of them contained small spaces filled with old blood. These tumors proved to be adenomyomata of the umbilicus. To Goddard belongs the credit for first properly interpreting these tumors.

More recently adenomyoma of the rectovaginal septum has been noted. Cuthbert Lockyer and Jessup have each recorded two cases and I have had four. In 1899 my colleague, Dr. William W. Russell[3] reported a case in which a large amount of uterine mucosa was found in the hilum of the ovary. In this instance, however, no myoma existed.

From the foregoing, it will be seen that we may find adenomyoma in the uterus, round ligaments, rectovaginal septum, or in small umbilical tumors.

Nearly three years ago I encountered another adenomyoma of the round ligament. Of this case I herewith give a brief report:

Mrs. J. Q. J., aged 43, was referred to me by Dr. N. C. Trout, of Fairfield, Pa., and admitted to the Church Home and Infirmary March 6, 1913. She had complained of a lump in her groin for several years. This was very firm and appeared to be cystic. It was about 4 cm. long, 2 cm. broad, and somewhat lobulated (Fig. 1). She also complained of pain in the appendix region.

Operation. I first made a median incision and found the rectum firmly adherent to the left ovary

Fig. 1. Adenomyoma of the round ligament and incarcerated omentum contained in an inguinal hernia, together forming one nodule.

Gyn.-Path. No. 19,018. The nodule lay a little above Poupart's ligament. It was 4 cm. long, 2 cm. broad, and somewhat lobulated. It was preceptibly larger at each menstrual period. At operation the upper part of the tumor was found to be very dense and intimately blended with the fascia. It contained cyst spaces, some of which were filled with chocolate-colored fluid. The lower portion of the nodule consisted of omentum which had emerged at or near the internal inguinal ring. The histological appearances are shown in Figs. 2, 3, and 4.

[2] Cullen, Thomas S. Adenomyoma of the round ligament, Johns Hopkins Hosp. Bull., 1896, May and June, Nos. 62 and 63; Adenomyoma uteri diffusum benignum, Johns Hopkins Hosp. Reports, 1896, vi; Further remarks on adenomyoma of the round ligament, Johns Hopkins Hosp. Bull., 1898, No. 87 (June); Adenomyoma des Uterus, Verlag von August Hirschwald, Berlin: 1903; Adenomyoma of the Uterus, 1908; Adenomyoma of the uterus, J. Am. M. Ass., 1908, January, i, 107; Umbilical tumors containing uterine mucosa or remnants of Mueller's ducts, Surg., Gynec. & Obst., 1912, May, 479; Adenomyoma of the rectovaginal septum, J. Am. M. Ass., 1914, lxii, 835.

[3] Russell, William W. Aberrant portions of the Muellerian duct found in an ovary. Johns Hopkins Hosp. Bull., 1899, x, 8.

[1] From the Gynecological Department of the Johns Hopkins Medical School and of the Johns Hopkins Hospital. Read before the Southern Surgical and Gynecological Association, Cincinnati, December 13-15, 1915.

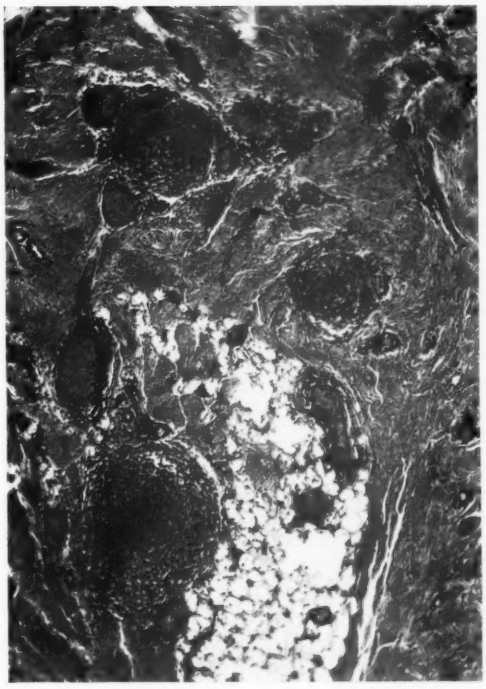


Fig. 2. Apparently discrete myomatous nodules in an adenomyoma of the round ligament. Gyn.-Path. No. 19,018. The greater part of the specimen stains diffusely. It consists chiefly of fibrous tissue and contains non-striped muscle. It will be noted that the adipose tissue at the bottom is being irregularly replaced by fibrous tissue. There are three distinct areas that have a whorled appearance. They form a roughly triangle in the picture. These areas are very cellular, and closely resemble young myomata. They may possibly, however, be very cellular areas of the characteristic stroma that usually surrounds uterine glands.

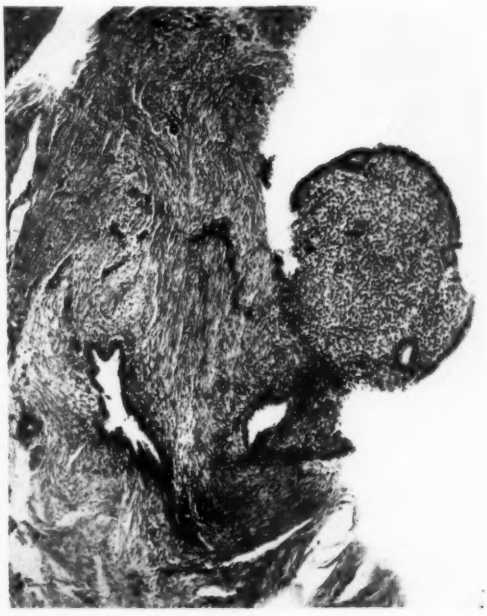


Fig. 3. Adenomyoma of the round ligament. Gyn.-Path. No. 19,018. The solid portion of the specimen consists of non-striped muscle and fibrous tissue. A little below the center of the field is a gland lined with one layer of cylindrical epithelium. In some places it is separated from the tumor proper by a definite stroma.

Projecting from the surface on the right of the specimen is a dome-shaped mass of tissue very rich in cells with oval nuclei. This tissue is identical in every way with the characteristic stroma of the uterine mucosa. In the lower part it contains a small gland lined with one layer of cylindrical epithelium. The surface of this dome-shaped mass of stroma is covered over with one layer of cylindrical epithelium.

The entire picture is that of a typical adenomyoma. The dome-shaped mass of mucosa evidently projected into one of the cyst-cavities noted macroscopically.

over a considerable area. The adhesions were gradually loosened and the raw area on the bowel was closed. The lumen was not injured. I then examined the omentum and found that it passed down through a hernial opening near the right internal inguinal ring and then directly out into the adipose tissue of the anterior abdominal wall. The omentum was cut off at the internal ring, tied, and pushed out of the way. The extraperitoneal portion of the omentum was left undisturbed. The peritoneum over the internal ring was now closed from within. I then removed the appendix which showed evidence of old inflammation, there being present adhesions passing off from it in various directions.

After closing the abdomen I made an incision over the tumor in the right inguinal region. This tumor was adherent to the skin. The skin was dissected back and the mass literally cut away from the fascia. There were numerous cysts, some filled with clear contents, others with a slightly turbid fluid, and quite a number with chocolate-colored fluid, strongly suggesting adenomyoma. Adenomyoma was considered probable, some stress being laid upon the declaration of the patient that the lump appeared to increase in size at each menstrual period. After dissecting away the lower portion of the tumor, which was also adherent to the fascia, I now lifted up the omentum from the hernial opening. The hole left near the internal ring was slit-like in form, about 1 cm. long and 4 mm. broad. It was closed with kangaroo tendon. To dissect back the fascia, and do an orthodox operation

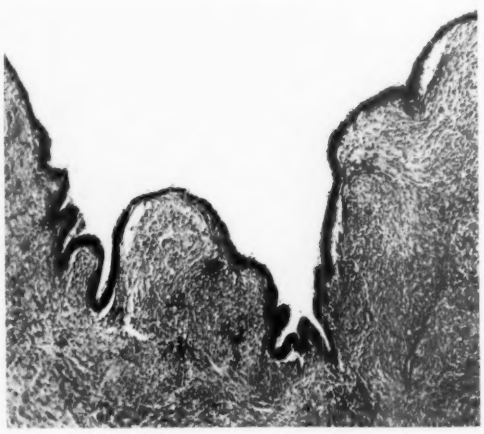


Fig. 4. The lining of a cyst in an adenomyoma of the round ligament. Gyn.-Path. No. 19,018. The tumor consists of fibrous tissue and non-striped muscle. The inner surface of this cyst was undulating and had numerous depressions running off from it. These depressions may with equal propriety be described as glands. The cyst is lined with one layer of cylindrical epithelium, which at the more prominent or exposed points has become cuboidal.

was out of the question, because of the large defect that would have been left. At most points good firm scar-tissue existed. I closed the wound with through-and-through silkworm-gut sutures; accurate skin approximation was made with fine black silk. The lower angle of the wound was drained with protective. The patient made a good recovery.

On December 8, 1915, Dr. Trout wrote me, saying that he had just spoken to the patient. She has had no return of the trouble, is free from pain, and has gained twenty pounds.

Gyn.-Path. No. 19,018. The outlying portion of the tumor consisted of fat with here and there yellowish or brownish pigmentation, suggesting the pigment of old hæmorrhage. The central portion of the tumor closely resembled fibrous tissue. It had cystic spaces scattered throughout it. The contents of these varied, as noted above, some being clear, others turbid, and some being filled with chocolate-like material.

Histological examination. The outlying portion of the specimen consisted of adipose tissue. As one passed toward the tumor, the fat was gradually and irregularly replaced by fibrous tissue, which in many places had undergone almost complete hyaline transformation. Scattered here and there throughout the fibrous tissue were large or small areas of non-striped muscle. Several very small discrete myomata were also noted (Fig. 2). At numerous points in the tumor were glands, tubular or round and lined with one layer of cylindrical epithelium (Fig. 3). Some of the glands lay in direct contact with the fibrous tissue or muscle; others were separated from the tumor by the characteristic stroma of the mucosa. The cyst spaces noted macroscopically were lined with one layer of cylindrical epithelium (Fig. 4).

From the description it is perfectly clear that this was an adenomyoma of the round ligament associated with a large amount of fibrous tissue. From a clinical standpoint the coexistence of a small inguinal hernia with incarcerated omentum and an adenomyoma of the round ligament is very interesting. The increase in size of the inguinal nodule at the period naturally made me suspicious of adenomyoma, and the indications supplied by the presence of old pigment in the fat at operation, coupled with the fact that some cysts contained chocolate-like material, justified a tentative diagnosis that the tumor was an adenomyoma even before the microscopical examination. I have not as yet gone over the recent literature, but do not know of any other case in which an inguinal hernia and an adenomyoma were found in the same hernial protrusion.

EARLY TUBERCULOSIS OF THE CERVIX [1]

By THOMAS S. CULLEN, M.B., F.A.C.S., Baltimore, Maryland

A FEW weeks ago, when taking up diseases of the cervix with my class in Gynecological Pathology at the Johns Hopkins Hospital, we encountered the following striking example of very early tuberculosis of the cervix:

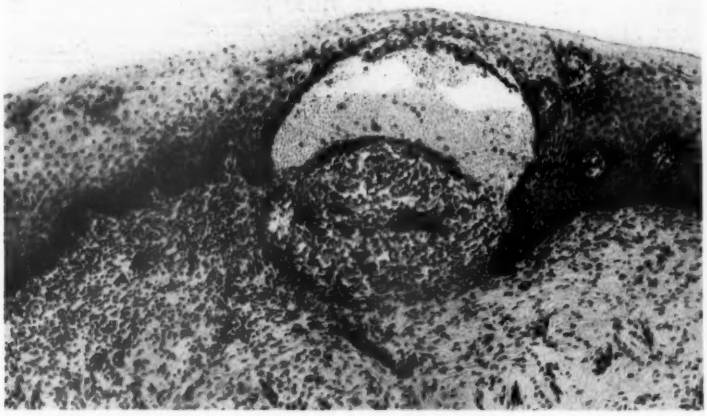
Gyn. Nos. 19,534 and 20,660. The patient, a healthy looking colored woman, 25 years of age, was admitted to the Johns Hopkins Hospital on October 16, 1914, complaining that she had been discharging fæcal matter through the vagina for two years. She had been married six years but had never been pregnant. Her menses had begun at 19, but for the last five years she had had no periods.

At operation Dr. J. Craig Neel, the resident gynecologist, found the uterus in retroposition and the bladder adherent to it above the internal os. The sigmoid was adherent to the vesico-uterine reflection just above the level of the internal os. The right tube and ovary had become twisted over the anterior surface of the uterus.

The bladder and tube were freed and the fistula between the vagina and rectum was cut across. The small opening in the sigmoid was closed. The uterus which contained several myomata was now removed, a complete hysterectomy being done.

The laboratory diagnosis was: *bilateral follicular salpingitis, uterine myomata, tuberculosis of the endometrium, tuberculosis of the cervix.*

The photograph of an area from the section of the cervix shows at each outer portion of the picture normal squamous epithelium with a normal underlying stroma. In the center, the superficial portion of the squamous epithelium is still intact; the underlying layers of epithelium are missing, and a crescentic space is seen filled with blood. Immediately beneath this is a tubercle, occupying partly the epithelial layer and partly the underlying stroma. It is sharply circumscribed, consists of epithelioid cells and contains several types of giant cells. The stroma on the left shows small round-cell infiltration.



Gyn. Nos. 19,534 and 20,660; Gyn.-Path. No. 20,640. The tuberculous process was much more advanced in the mucosa lining the cavity of the uterus than in the cervix. The cervical mucosa is intact. In the center of the field is a well-defined tubercle consisting of epithelioid cells and containing giant cells of various types. Between the tubercle and the overlying squamous epithelium is a crescentic space filled with blood. The stroma to the left of the tubercle shows some small round-cell infiltration.

Tuberculosis of the cervix is rare, and such an early stage as is here depicted I have never seen before.

From the Gynecological Department of the Johns Hopkins Medical School and of the Johns Hopkins Hospital. Read before the Southern Surgical and Gynecological Association, Cincinnati, December 13–15, 1915.

CAUDAL ANÆSTHESIA IN GENITO-URINARY SURGERY[1]

By BRANSFORD LEWIS, B.S., M.D., F.A.C.S., and LEO BARTELS, M.D., F.A.C.S., St. Louis

HISTORY

In 1901 and 1903 Cathlin [2] proposed the use of normal saline injections into the sacral canal for the purpose of allaying certain nervous manifestations connected with the urinary tract: enuresis in boys and girls, tabetic crises, etc. Encouraged by some success in this endeavor, the same author later tried to induce anæsthesia by injecting in a similar manner, but this proved unsuccessful with him and with other French experimenters of that period.

It was not until 1910 that material success was reported in this regard. Then Laewen [3] described his use of one to two per cent solutions of novocaine in normal saline solution, used in this way and the anæsthetic effect he secured therefrom.

Gros [4] advised an alkaline base for the solution as promoting the intensity of anæsthetic effect, and made use of novocaine bicarbonate, together with a small addition of adrenalin.

Laewen made use of the sitting posture for the patient until the anæsthesia was well under way, and began with 20 or 25 ccm. While he mentioned that the anæsthetic effect was somewhat variable, he claimed that very satisfactory results were obtained in many instances. Analgesia had been noted in the gluteal region, rectum and anus, skin of the scrotum and penis, and of the upper and inner parts of the thigh; and in women, the vulva and vagina. Laewen thought that probably the prostate, also, would be found to be analgetic through the same agency, though up to the time of his report he had had no opportunity of confirming this belief.

In reviewing the subject of nerve-blocking for local anæsthesia, Harris [5] mentioned the sacral method and reported having used it with good effects. This was our first introduction to the method. While we then had little to go on, the method seemed logical; and we had had experience with Cathlin saline injections in certain cases with varying success but no bad effects.

To date we have essayed caudal anæsthesia in some eighty-five cases, with results so favorable that we feel justified in making the report herewith presented.

ANATOMY

Thirty-one pairs of nerves branch off from the spinal cord, emerge through the foramina, and are distributed to the several parts of the body which they innervate. They are divided into five groups, the cervical, dorsal, lumbar, sacral, and coccygeal.

Sacrum. Although originally composed of separate segments, the sacrum in adult life is blended into one bone. For present consideration its most interesting features are its *central canal* and its *foramina* (Fig. 1). The canal is a continuation downward of the spinal canal, but at the second sacral segment communication between these two parts is cut off by the closure of the dura mater around the nerve branches (Figs. 2 and 3). This is not only demonstrable anatomically, but Laewen[6] found that colored fluids injected into the sacral canal never appeared in the spinal canal or colored the upper part of the cord, showing the complete isolation of these two parts of the canal from one another by

[6] Laewen and Gaza, D. von. Zeitschr. f. Chir., 1911, p. 300.

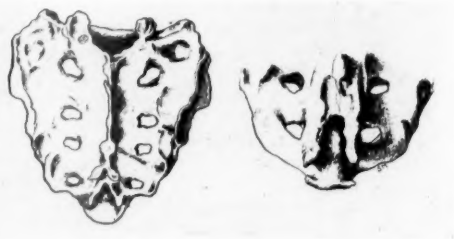


Fig. 1. Sacra, and varying forms of sacral hiatus. (P. Bull.)

[2] Cathlin. Les injections epidurales. Paris: 1903, p. 89.
[3] Laewen. Zentrbl. f. Chir., 1910, No. 20.
[4] Gros. Arch. f. exper. Path. u. Pharm., p. 708.
[5] Harris. Surg., Gynec. & Obst., 1915, xx, 193.

[1] Read before the Southern Surgical and Gynecological Association, Cincinnati, December 13–15, 1915.

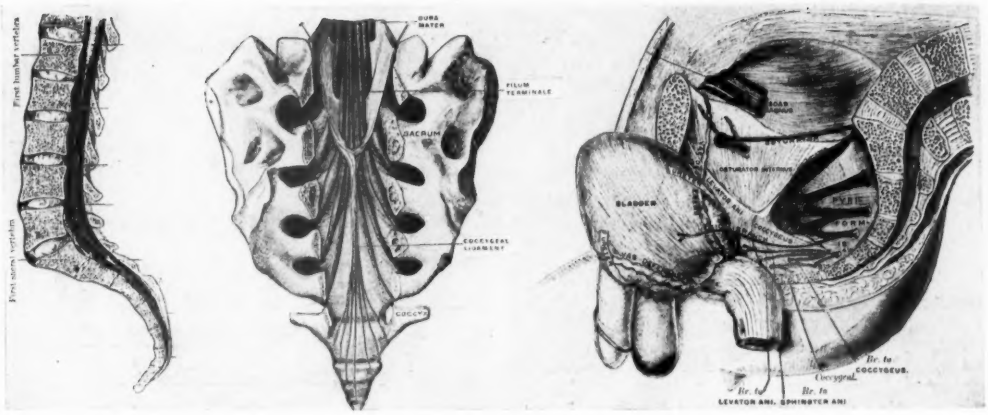


Fig. 2 (at left). Sagittal section of spine, showing spinal and sacral canals (Cunningham).

Fig. 3. Showing separation of spinal and sacral canals by closure of dura mater. Sacral nerves exposed (Gray-Spitzka).

Fig. 4. Sacral plexus of nerves and distribution (Gray-Spitzka).

closure of the dura mater. So that although the nerves are transmitted from the spinal canal down into the sacral canal, there is no other communication between the two. This fact marks the distinction between this method of securing anæsthesia and that termed spinal anæsthesia, in which the fluid is injected directly into the spinal canal. It likewise indicates that the two methods should not be confused with one another.

The nerve branches that descend thus from the spinal into the sacral canal are called the sacral nerves. From the sacral canal they pass through the sacral foramina out into the pelvis, forming then the *sacral plexus* (Fig. 4), one of the most important of whose branches is the pudic, distributed to the genito-urinary organs.

The sacral canal is enclosed in bony walls except at its lower end; here through non-development of the spinous processes the posterior bony wall is lacking and is replaced by a ligamentous membrane or covering. This opening is called the *sacral hiatus*.

It is through this hiatus that the hypodermic needle is directed for delivery of the fluid for anæsthesia. The opening is variable in size in different individuals (Fig. 1), but is practically always large enough to permit the introduction of a needle.

The sacral canal is flattened from before backward, and its caliber grows smaller as it curves downward toward the coccyx (Fig. 2). In the male the curve of the sacrum is fairly evenly distributed over the whole length of the bone, but in the female the upper part or base of the sacrum is projected more sharply backward for the increase of pelvic capacity pertaining to that sex. These variations have an influence on the ease or difficulty of introducing the long hollow needle through which the injection is made. The axis of the canal must be threaded by compensating movements while advancing the needle.

Distribution of nerves from the sacral plexus. The chief divisions of the sacral plexus are the sciatic and pudic nerves. The pudic terminates in three branches; namely, (1) the dorsal nerve of the penis, (2) the perineal nerve, and (3) the hæmorrhoidal. These supply the skin and the structures of the penis, scrotum, perineum, prostate and bladder; and the inner surface of the thighs posteriorly. A structure *exclusively* supplied by a certain nerve may be anæsthetized by deadening that nerve; but when the structure is supplied by another nerve, also, the deadening of one nerve only does not suffice for anæsthesia; the collateral nerve holds the tissues in a sensitive condi-

Fig. 5. Landmarks for caudal anæsthesia.

Fig. 6. Finger covering the hiatus.

tion. This accounts for the fact that the lower extremities are not made analgesic by anæsthetizing the sciatic nerve. Collateral innervation maintains sensibility.

PREPARATION OF SOLUTION

Various drugs have been added to the novocaine solution to make its effect more efficient and enduring, but our experience has led us to believe that the two most useful adjuvants in this respect are potassium sulphate and adrenalin. The addition of these drugs permits the use of novocaine in much weaker solution while still retaining its effectiveness.

Chloretone, although a local anæsthetic and antiseptic, has been discontinued by us because of its irritating effects and also because analgesia has seemed just as good without it. The following solutions are freshly prepared before using:

A. One per cent solution of novocaine.

B. One per cent solution of potassium sulphate.

When ready for use these two solutions are combined in a sterile glass, and two drops of adrenalin solution (1:1000) are added for each 30 ccm. of the combined solution. Freshly distilled sterile water should be used for making the solutions.

Dosage. From forty to ninety cubic centimeters of the combined solution is injected, according to each individual case; the more sensitive individuals and the major operative procedures requiring the larger amount.

Prostatectomies demand larger quantities and more complete anæsthesia. If one injection does not produce sufficient anæsthesia, an additional amount may be used.

Tests for insensibility. It is not advisable to apply tests before fifteen minutes following the giving of the injection. They are liable to lessen the confidence of a nervous patient in the success of the method. At twenty minutes the effect should be manifest or at its best. In prostatectomies or vesical operations, a part of this time is occupied in making the prevesical incision under ordinary infiltration anæsthesia (Fig. 9). When the operator arrives at the bladder wall he finds it insensitive and ready for incision. Previous to this, if desired, a test may be made by sounding the prostatic urethra and bladder, both of which should be influenced by the caudal anæsthesia.

SUCCESS AND FAILURE

Just as with the use of drugs for any purpose and by any method, so there is a certain variability in the effectiveness of this method for producing anæsthesia. Aside from individual susceptibility, there may be other reasons explanatory of this. The capacity of the sacral canal may be large or small, requiring a greater or lesser amount of fluid to fill it and exercise the pressure-effect on the nerves that is so essential.

We have found it serviceable to use a

larger quantity of the more dilute solution than was formerly employed. Eighty or ninety ccm. of the one-half per cent solutions seems preferable to half that quantity of one per cent solutions.

Laewen reported 15 per cent failure in forty-seven cases, using 20 to 30 ccm. of 1 to 2 per cent solutions. Our earlier experience gave about the same percentage of success (85), which seems likely to be improved under further study and use of the method. Its newness to us, together with the paucity of literature regarding it, led us to feel our way in increasing the quantity of fluid injected rather than striving too ardently for uniform success.

But latterly we have used eighty or ninety ccm. of anæsthetic fluid in a number of cases, without observing that it induced any more disturbance than the lesser quantities had given. The hypodermic administration of morphine or pantopon, given shortly beforehand, contributes to the effectiveness of the result.

Harris says that so far the nerve-blocking methods have been accompanied by no mortality. With two possible sources of danger eliminated, the sacral method of nerve-blocking would seem capable of maintaining that enviable reputation. These possible dangers are, injection of the fluid into a vein (Fig. 8) and injection into the spinal canal. They are obviated by definite maneuvers related in the description of technique.

It is difficult to anticipate any other cause for anxiety in this respect.

The difficult cases for caudal anæsthesia are the obese, the very nervous, the hysterical, and children. Laewen has advised against its use in the aged, but we have found that these are the very cases in which it is especially advantageous. It has made operation possible in a number of cases debilitated and decrepit from advanced age and the ravages of urinary obstruction and sepsis, its freedom from shock and other depressing influences making it particularly desirable for this class of cases.

TECHNIQUE OF ADMINISTRATION

The patient is placed on his right side, with his head slightly elevated, and is instructed to bow his back strongly, bringing his knees and chin as near together as possible.

Fig. 7. Needle inserted into sacral hiatus.

The area over the sacrum and the immediate neighborhood is cleaned with benzine, dried, and painted with iodine.

The sacral hiatus is sought for and is found just below the spinous process and above the coccyx (Figs. 5 and 6). The rudimentary sacral spinous processes lead down to it.

Having infiltrated the skin and deeper soft tissues over the hiatus with the same anæsthetic fluid as is to be used for the sacral canal, a little massage serving to diffuse the solution to better advantage, the long needle fitted with a trocar wire is inserted into the sacral hiatus (Fig. 7), passing through the membrane that covers the hiatus. The needle in being introduced is at first held at an angle of 45 degrees with the skin surface, but as soon as the operator feels the penetration of the membrane by the needle, the syringe is depressed almost to a level with the body-plane at that point.

The needle is made to follow the axis of the canal, which it penetrates for a distance of 1.5 or 2 inches. When placed the trocar wire is withdrawn, and opportunity is given for avoiding the two dangers previously alluded to. If the needle has gone up too far and passed through the guarding dura mater into the spinal canal evidence will be given in the escape of numerous drops of spinal fluid through the needle. In this case

Fig. 8. Venous plexus of spinal column (P. Bull).

Fig. 9. Infiltration of suprapubic tissues.

the needle must be withdrawn until its point rests in the sacral canal and no more spinal fluid flows. If there is bleeding, indicating that a vein has been punctured, the position of the needle is changed so that an inadvertent intravenous injection be not given. In case there is no bleeding it is well to make assurance doubly sure before injecting the anæsthetic fluid. To that end a few drops of normal saline solution are first injected and permitted to return through the needle, thus removing a possible clot or shred in the needle. Blood will assuredly flow at this point if a vein be the resting place of the needle.

If not, and all things seem satisfactory, the injection is proceeded with; 20 ccm. at a time being sent slowly and steadily through the needle by the Record syringe, repeated until the desired quantity is reached.

Some patients indicate the blocking effect on the nerves by complaining of pains or peculiar sensations down the thighs and legs. It has seemed to us that anæsthesia portended better when such complaints were made.

Occasionally it is found that a curved needle is more favorable for threading the canal than a straight one, conforming to a more sharply curved canal or a smaller hiatus.

Fig. 10. Prostate and vesical stone removed under caudal and infiltration anæsthesia.

UNTOWARD EFFECTS

On one occasion, before the technique described was adopted, the beginning of the injection was marked by emphatic complaints by the patient of severe pain in the head and chest, weakness, with undue frequency and irregularity of the pulse. It was recognized at once that the injection was *intravenous* and it was promptly discontinued. The symptoms passed off shortly afterward and there was no objectionable after-effect.

At other times we have noted transient indications of weakness, moisture of the skin, frequent pulse, etc., but whether these were due to the effects of the injection or to nervousness and apprehension on the part of the patient, it has been difficult to say. We have had patients that fainted incidental to a

rectal palpation of the prostate, from the strangeness of the situation and nervousness of the patient. So that it is not always easy to differentiate between nervousness and toxicity. However, the effects have never proved serious in any case as yet.

If less than a toxic amount of novocaine be used, and it is used under the plans and precautions described, we can see no reason why it should prove dangerous or show a mortality.

TOXICITY

In referring to the toxicity of novocaine, Braun [1] says that while he had never noticed any disturbance following the subcutaneous injection of 2 per cent solutions, Laewen had observed typical poisoning symptoms following the injection of 25 ccm. of 2 per cent solution into the sacral canal. The symptoms consisted of nausea, sweating, anæmia, rapid pulse, frequent respiration, feeling of oppression, and haze in front of the eyes. The authors had noted that these symptoms could be avoided by making the injection slowly. In experimenting on the nerve-trunks of the lower extremities, Laewen had used as much as 2.1 grains of novocaine without toxic effect. In one case the patient had received 20 ccm. of 4 per cent solution; in another 30 ccm. of 2 per cent solution. He has injected 50 ccm. of 1 per cent solution and larger quantities of 0.5 solution. In only a few of the cases were toxic symptoms noticed. Finally (ibid., p. 180) Braun remarks that, "since Laewen has shown that the 4 per cent novocaine-suprarenin solution is harmless, even in large quantities, the author has been using this solution." And he further remarks: "The toxic action of this drug is less than that from any hitherto known anæsthetic substance."

ADVANTAGES OF SACRAL ANÆSTHESIA

The pre-eminent advantages of this method do not appear in ordinary routine surgical cases. These can be anæsthetized with ether or gas-oxygen with little risk, if administered by an expert. But when an aged individual, so reduced by pain and toxæmia, and by back-pressure in his urinary tract that he is utterly miserable and decrepit; so debilitated that he has no resisting powers to stand further depletion; and seems both ripe and ready for dissolution; and so old that there is no promise of restoration from this source; then we have the patient for whom this mode of anæsthesia is appropriate and most advantageous. It is a question then of safety first, of life and death, not simply a choice between several equally safe methods of anæsthesia.

Anæsthetized by this method, we have seen just such cases undergo various operative measures connected with the bladder and prostate, who both during and after such operations were serene and comfortable, free from cardiac, pulmonary, or gastric disturbances, and ready at once to take liquids and light nourishment.

ILLUSTRATIVE CASES

CASE 1. P. K—y, age 63, laborer, poorly nourished, chronic rheumatic and inebriate; poor risk from every standpoint. Arteriosclerosis and myocardial degeneration present. Urinary tract septic, urine loaded with pus and bacteria; urination every five to forty minutes. Repeated septic chills and fever. Cystoscopy showed large intravesical prostatic hypertrophy, together with a stone almost as large as a hen's egg. After five days' preparatory treatment, the patient was operated on by the suprapubic route, under caudal and infiltration anæsthesia as described, the specimens shown in Fig. 10 being removed. The patient suffered none at all, either from pain or shock; and expressed himself as more comfortable after operation than before it. Recovery was uneventful and the patient was ready to leave the hospital in three weeks.

CASE 2. Wm. McG—n, age 76, very feeble, ill-nourished, emaciated, and cachectic. First essay at cystoscopy under ordinary methods of local anæsthesia was a complete failure, the patient squirming and resisting to a degree that prevented even the introduction of the instrument into the bladder. With this experience in mind, and with memories of previous attempts at instrumentation by other surgeons, the patient very impressively informed us that he would submit to operation or anything we wished to do, *only on condition that it was done under ether anæsthesia.* In this stand he was backed up by his family. His enfeebled condition made it highly desirable that he be operated on without the addition of any factors of shock or disturbance. Bronchitis present forbade the use of ether.

A little diplomacy paved the way to the use of

[1] Braun. Local Anæsthesia. Translated by Shields, 1914, p. 124.

caudal anæsthesia for a second attempt at cystoscopy, five days after the first one. The effect was all that could be desired. The patient was comfortable throughout; relaxation permitted the introduction and complete manipulation of the cystoscope, and from this very satisfactory examination there was confirmation of a previous suspicion of prostatic carcinoma. This diagnosis explained the hyperesthetic condition prevailing locally, as well as the unpromising condition generally. Nevertheless, it was still considered advisable to operate to relieve the obstruction and sepsis present.

The caudal anæsthesia had been so eminently pleasing to the patient that he made no further objection to its use in the subsequent major operation; and it was applied with equally as much satisfaction. After suprapubic opening of the bladder, the larger proportion of the growth, hard, dense and resistant, was removed by digging, tearing and morcellement, leaving at least a good channel for the escape of urine, if not preventing the future return of the growth. The latter had involved adjacent structures to a degree that made radical removal out of the question.

But the caudal anæsthesia was both effective and innocuous, the patient was in as good condition after the operation as before, and his progress since then has shown that neither operation nor anæsthetic added to his disability or distress and it is expected that the remaining tenure of life may at least be more comfortable.

Other, simpler cases might be related in which everything has gone more evenly than in these, but it must be remembered that it is solving the difficult and unpromising cases that makes the method attractive or worthy.

Total number of cases	85
Divided as follows:	
Prostatectomies	13
Cystoscopies	68
Cystotomies	2
External perineal urethrotomy	1
Rectal carcinoma	1

RESULTS

Ten of the 13 prostatectomies needed no other anæsthesia; 2 required a small amount of ether.

One required complete ether anæsthesia, there being no effect from caudal injection.

Of the 68 cystoscopies forty-six gave excellent analgesia.

Thirteen gave partial analgesia.

Five gave no analgesia; 3 of these 5 failures we believe due to faulty technique.

One of the cystotomies (for calculus) gave good analgesia and the prostate could have been enucleated.

One required a small amount of ether, as curettement of a carcinomatous mass was done.

The one case of external urethrotomy (perineal) gave complete analgesia.

The one rectal case (carcinoma) was a failure.

RESULTS OF OPERATIONS FOR EXOPHTHALMIC GOITER[1]

By E. S. JUDD, M.D., F.A.C.S., Rochester, Minnesota,

AND

J. D. PEMBERTON, M.D., Rochester, Minnesota
Fellow of the Mayo Foundation

IN this review of cases of exophthalmic goiter, we have endeavored to ascertain as nearly as possible the results of operation for the condition. As is well known, it is difficult to determine when a condition of this kind is cured, and that some of the patients who are apparently cured may ultimately have relapses. In order that a sufficient length of time should have passed since operation, only the patients operated on in 1909 and in whom a definite diagnosis had been made were selected for this study.

The diagnosis of exophthalmic goiter in these cases was based on the clinical history and the histologic changes in the tissues when a part of the thyroid was removed. In a certain number no tissue was removed, ligation of the thyroid vessels only being done. In most instances, however, the thyroid was resected. The cases were all in the hyperplastic, toxic group, as described by Plummer and Wilson. (There was a definite so-called hypertrophy in all of the thyroids removed which was diagnosed by the clinician as exophthalmic goiter and by the pathologist as hyperplastic thyroid.)

Of the 176 patients in the series operated on in 1909 we have been able to trace 121 by correspondence and subsequent examinations. A number of these have returned several times for examination, and many of them have reported by letter several times.

It has been our custom to ligate the superior thyroid vessels in two types of exophthalmic goiter cases. In one type the disease was mild and we hoped the procedure might be sufficient to effect a cure. In the other type the disease was severe, and one or more ligations were done as a preliminary to resection. These patients were advised to return in three months for the removal of a part of the gland, but some of them were so greatly improved by the ligations that they did not return. Of the 121 patients that were traced, 56 were ligated; 36 had primary resections of the thyroid; 20 had preliminary ligations followed later by resections. Nine of these patients were operated on for recurrence at which time either one of the vessels was ligated or a part of the remaining piece of the thyroid was resected. The patients have been classified in five groups.

Group I. In this group there were 55 (45.4 per cent) patients cured; i.e., those who had been well for some time and as far as they knew, or as we could judge, were completely relieved of all their former symptoms. In 16 of the 55, primary resections had been done; in 11 resections following ligations; in 24 ligations alone; and in 4 secondary ligations or resections following resections. We believe that the preliminary ligations should nearly always be followed by thyroidectomy, and that when ligations alone are done, late recurrences are much more common. On a number of occasions we have done thyroidectomies for the recurrence of symptoms after patients had been well for more than five years following ligation. One patient in this group was well for more than five years after the ligation of both superior thyroid vessels; then all the symptoms of hyperthyroidism gradually returned and the gland was resected. The following histories are illustrative of the cases in this group:

Case 1. Mrs. A. M. B., (A30,233), aged 27 years. Examination October 18, 1909. Acute symptoms of hyperthyroidism began about five and one-half years before. Enlargement of the thyroid was first noticed five years before. Six months before the appearance of the goiter she began to lose weight, was restless, irritable, and had slight tremor and general nervousness. Pulse 60. Two weeks after the goiter appeared, there was a rather sudden onset of tachycardia with diarrhœa. Pulse 170. There had been nausea and vomiting and œdema of the feet for six weeks. All the symptoms, except gastro-intestinal, had continued for two years.

[1]Read before The Southern Surgical and Gynecological Association, Cincinnati, December 13–15, 1915.

She was exhausted, unable to work, and lost 20 pounds during this time. During the last three years there had been gradual improvement. At the time of examination the pulse was 130; there was dyspnœa, exhaustion on exertion, and restlessness. There was very little change in the size of the goiter, if anything it was a little smaller. She had some difficulty in swallowing. Electrical treatments had been given. The thyroid was firm, the right lobe larger than the left. The heart was regular and not enlarged. Her strength was fair, and nutrition good. The exophthalmos which had existed for five years was quite marked, uneven, more noticeable on the right side.

On October 20, 1909, the right lobe and isthmus were extirpated. The pathologist reported hyperplastic thyroid. The patient had a normal convalescence and left the hospital in a few days. She was the wife of a physician and we were thus able to follow her condition accurately. One year after the operation only a slight trace of trouble remained. Four years later her husband reported that she was entirely well though the right eye was still a little more prominent than the left. At the present time, she is entirely recovered and there is no evidence of her old trouble. A letter from the patient states that it was about two years after the operation before she considered herself well. She now works with perfect ease. Her pulse is about 80. She has gained about ten pounds in weight. Her voice is clear. She is in fact in splendid health.

Case 2. Dr. N. B., (A29,110), male aged 27 years. Examined September 17, 1909. The goiter was first noticed two years before. Hyperthyroidism probably started at about the same time. A small nodule in the right lobe of the thyroid was first noted, since which time there has been tachycardia and some loss in weight and strength. From that time palpitation, tachycardia, and loss of weight has been variable. He had spells of diarrhœa for two or three days at a time; sweating profusely. He first noticed exophthalmos about six months before. Tremor was not noted until a few months before, since which time the symptoms gradually became more severe. The thyroid was rather soft, and the right lobe somewhat larger than the left. There was slight enlargement throughout the gland. The heart was normal in size. The pulse was 120, soft and slightly irregular. The white blood count was 6,320, total lymphocytes 49 per cent. Operation September 20, 1909. Extirpation of the right lobe and isthmus. Pathologic report: hyperplastic thyroid.

One year after the operation this patient reported that he was much improved though there was still slight evidence of the old trouble. Six months after the operation he had had a relapse of the tachycardia, but this cleared up in a few months. He can now do as much work as he could before the beginning of his trouble. The exophthalmos has entirely disappeared. Present average pulse rate 85; normal weight before his trouble began was 150 pounds, present weight is 165 pounds. His voice was not affected by the condition.

Case 3. F. E. K., (A20,797), male aged 40 years. Examination March 2, 1909. The goiter was noticed nine months before, though there may have been some evidence of hyperthyroidism for two years. He had acute illness two years before which was called la grippe. He had been a little nervous for years and thought that his present trouble has been coming on gradually for several years. He had lost 30 pounds in weight and complained of weakness, nervousness, and dyspnœa on exertion. There had been no vomiting or diarrhœa. Examination showed a hard gland, generally enlarged. No dilatation of the heart and no evidence of myocarditis. Pulse 120 to 130. Exophthalmos regular and quite marked. The first operation was done March 6, 1909, when the right lobe and isthmus were extirpated. After this he felt fairly well when resting. He grew stronger, less nervous, and gained 10 pounds in weight immediately after the operation, but lost it after working two weeks. When he returned for examination October 22, 1909, his pulse was 120. During August and September he had about ten attacks of biliary colic, with diaphragmatic spasms, and was obliged to take morphine several times on account of pain. October 29, 1909, the left lobe was resected. The pathologic report on both pieces of tissue was hyperplastic thyroid.

This man reports that about 8 months elapsed after his second operation before he considered himself entirely well, but he is as well as before he began to have the trouble. He can now do his work with ease. The prominence of his eyes has disappeared. He regained the 30 pounds in weight and now weighs 150 pounds. This patient has recently undergone a successful operation for gall-stones.

Case 4. A. M., (A26,401), female aged 16 years. Examination July 17, 1909. Goiter first noticed one and one-half years before. She had been nervous for several years and had noticed tremor. There had been a gradual onset of symptoms of hyperthyroidism, tachycardia, dyspnœa, palpitation, loss in weight, etc. Ten months before the symptoms had been severe and for several weeks she had been unable to be on her feet for any length of time. She had spells of diarrhœa lasting three or four days at a time and several spells of nausea and vomiting. Exophthalmos for eleven months. The thyroid was enlarged; thrills distinct; the left lobe larger than the right. The heart was dilated 1¼ inches to the left. There was a systolic murmur at the apex. The pulse rate was 150 and full. The white blood count was 8,000; total lymphocytes 42 per cent. Operation July 29, 1909; ligation of both superior thyroid arteries.

This patient writes that she is much stronger than at any time before she had the trouble. There has been no recurrence of symptoms and she can do more work than before. The prominence of her eyes has gradually diminished; the appearance of her neck is normal. Pulse 80; hands steady. She

has not taken medicine since her operation. She thinks that about six months elapsed before she was entirely well.

CASE 5. Mrs. A. O. M., (A27,574), aged 34 years. Examination August 1, 1909. This patient had a goiter at the age of 18 which disappeared. Her mother had one at 20 and it disappeared. The second goiter was first noticed about a year ago. Symptoms of hyperthyroidism, tachycardia, nervousness, and enlargement of the thyroid, had persisted for about five months. There was an irregular nodular enlargement of the gland. The heart was not dilated; pulse 110 to 120. There was some prominence of the eyes. The white blood count was 9,200; total lymphocytes 47 per cent. Operation August 18, 1909; ligation of the superior thyroid vessels. For more than two years after this, during which time she gave birth to a child, she felt well. In January, 1911, she returned, stating that for two months she had been having palpitation, dyspnœa, and nervousness, though not nearly as severe as before the ligation. She had lost 17 pounds in these two months. On January 10, 1911, the right lobe and isthmus were removed. Pathologic report: hyperplastic thyroid.

She now reports that she is well. She thinks it was about six months after the second operation before she was entirely well. She had a few slight temporary attacks of palpitation and nervousness. The prominence of her eyes has diminished. The pulse was 68. Normal weight before her first symptoms was 110; just previous to the thyroidectomy 98; present weight 124. She had no trouble with her voice. Her husband, who is a physician, writes that in his opinion she is as well now as before the beginning of her illness.

Group II. In this group of 22 patients (18.1 per cent) all were practically cured of their symptoms but still at times had slight evidence of the disease. Many of these are entirely well, though occasionally under sudden nervous strain they show that they are not entirely normal. In this group there were eleven primary resections, four resections following ligations, six ligations and one secondary resection. Some of the case histories are given as typical of results in the group.

CASE 6. Mrs. A. A., (A27,928), aged 28 years. Examination August 19, 1909. The goiter was first noticed two years before; the hyperthyroidism probably started five months before when the goiter rapidly increased in size. There was a sudden onset of typical hyperthyroidism, profuse sweating, rapid loss in weight, etc. Examination showed the thyroid generally enlarged, bruit and thrill marked over arteries. Pulse 160. Exophthalmos marked. Long, harsh systolic murmur. On May 24, 1909, both superior thyroid arteries were ligated.

One year after the operation the patient wrote that she was apparently entirely well. She now writes that she is not quite so well; is nervous at times, but does not think there is any evidence of her old illness. Her general strength is improved, but she tires more easily than before she had the trouble. A slight enlargement in the region of the thyroid can be felt. Pulse 85; weight about normal. No tremor.

CASE 7. Mrs. J. M., (A30,012), aged 54 years. Examination October 11, 1909. This patient noticed the goiter four months before. Hyperthyroidism had probably lasted about eight months. She was weak and unable to do her housework. She lost about 50 pounds in weight. Tremor gradually became worse, now affecting her entire body. She was nervous and irritable and perspired easily. The thyroid was found generally enlarged, the right lobe larger than the left. It was firm, rounded, and regular in outline. The heart was slightly enlarged; the heart sounds slightly deficient, regular at apex. There was a systolic murmur. The pulse was 120, regular, and of good quality. The white blood count was 9,900; total lymphocytes 35 per cent. Operation October 19, 1909: thyroidectomy; extirpation of the right lobe and isthmus. Pathologic report: hyperplastic thyroid.

This patient writes that all of three years elapsed before she considered herself well, and at present the condition of her nerves is not good. However, there has been no recurrence and no evidence of the old trouble. Her strength has improved; she is able to do her housework. No exophthalmos. No tremor. Weight before the appearance of symptoms was 180; previous to the operation 140; at present, 200 pounds. Her voice has not been affected.

CASE 8. D. B., (A26,468), woman, aged 43 years. School teacher. Examination July 19, 1909. The goiter was first noticed four months before at which time symptoms of hyperthyroidism developed: palpitation, tachycardia, dyspnœa, sweating. She complained of being hot; gradually developed tremor and diarrhœa. There was no vomiting. The symptoms were progressive until May or the first of June, when they reached their height. For some six weeks she could hardly get about. She was treated by rest and gradually grew better. Exophthalmos was present. The thyroid was hard with areas that felt cystic. The right lobe was considerably larger than the rest of the gland. The heart was dilated one-half inch to the left. There was a mitral systolic murmur. The pulse was 140, but with good tension. The white blood count was 10,000; total lymphocytes 30 per cent. On July 30, 1909, both superior thyroid arteries were ligated. This patient returned in May, 1911, stating that after the ligations she was in bed most of the time for three months because of palpitation and irregular heart action; since then she has been weak and unable to do much work. Palpitation occurs on excitement or exercise. Pulse from 80 to 90. Prominence of the eyes less. Operation

May 15, 1911: thyroidectomy; extirpation of the right lobe and isthmus.

This patient reports that her nerves are not so strong as they were before her illness. She is troubled more or less with sleeplessness, but her general health has improved and she can work with more ease. The prominence of her eyes has disappeared; there is no enlargement of the neck. Average pulse 80. No tremor. Normal weight 100; previous to operation 75; present weight 100. She cannot use her voice as well as she could.

Group III. In this group of 7 patients were those who reported that they were markedly improved, but most of the time there was some evidence of the old trouble and those who retained a little exophthalmos or nervousness. Most of them had entirely regained their normal weight and physical strength. Of the 7, 3 had been simply ligated. In all probability if these 3 patients and the 6 in Group II who had simply been ligated would have resections now the few remaining evidences of the disease might entirely disappear. One of the patients in Group III had a primary resection; 1 had a resection following ligation; and 2 had secondary resections. Typical case histories are as follows:

CASE 9. N. M., (A28,982), female, aged 24 years. Examination September 14, 1909. There had been gradual onset of nervousness, tachycardia, dyspnœa, sweating, etc., several years before, and the patient had stayed in bed the greater part of a year. She then improved until within the last three months when she became gradually worse. There was a firm prominence of the right and left lobes of the thyroid. Marked bruit of the upper poles. Heart regular; not dilated. Pulse 140. Marked systolic murmur at the apex. Exophthalmos quite marked. White blood count 6,000; total lymphocytes 33 per cent. Operation, September 22, 1909: ligation of both superior thyroid arteries.

Recent report states that she has never considered herself entirely well, though her strength has gradually improved. Pulse 92. There is some tremor; shortness of breath. Normal weight before her first symptoms 115 pounds; present weight 112. She has had an attack of jaundice, with rheumatism and gastric disturbance, since her operation.

Group IV. In this group we have placed 5 patients in whom there was slight improvement. In one a simple ligation had been done and this patient might now receive considerable benefit from a resection. As a rule, marked benefit follows ligation; if not, cure should not be expected in case the patient should have a thyroidectomy. Of these 5 patients, 3 had primary resections, and 1 was operated on a second time with little or no improvement. The following cases represent this group:

CASE 10. Mrs. A. G., (A23,024), aged 43 years. Examination April 30, 1909. Hyperthyroidism had existed for five years. She visited our clinic in 1904, when the diagnosis of Graves' disease was made. She was weak at that time and did not stay for treatment. She improved following this attack and her condition continued to be nearly normal for about a year. One year prior to her second examination she began to lose weight rapidly (15 pounds). After three or four months she again improved and was fairly well until April of the following year when she had a spell almost as serious as the first one. Exophthalmos at that time was quite marked. There was considerable enlargement of the right lobe of the thyroid, and slight enlargement on the left side. The heart was irregular in rhythm and force and was dilated one and one-fourth inches to the left. The pulse was regular, 114. The white blood count 5,700; total lymphocytes 36.6 per cent. August 5, 1909, double ligation of the superior thyroid vessels was done. August 26, 1909, the right lobe was extirpated.

This patient writes that she is not as well as she was before her original attack; her strength has improved, but her general health is not good. Pulse 80. No tremor.

Group V. The 8 patients in this group derived little or no benefit from the operation. One had a primary resection, 1 a secondary resection, and 6 were simply ligated. The following history is representative of this group:

CASE 11. Female, (A27,142), aged 19 years. Examination August 3, 1909. This patient had noted nervousness, not marked, for about three years. For the past nine months she had been easily exhausted. There were increased dyspnœa, nervousness, and difficulty in getting up stairs. She had two or three spells of vomiting; was frequently nauseated; her feet were swollen. The thyroid was found moderately hard and nodular. There were thrills over the superior thyroids. The heart was slightly dilated. The pulse was 144 and there was some exophthalmos. The white blood count was 6,200; total lymphocytes 34.9 per cent. Operation August 5, 1909; ligation of the superior thyroid vessels. May 9, 1910; thyroidectomy; extirpation of the right lobe and isthmus.

This patient has not been as well as she was before the beginning of her illness. Her general health improved for a time, but there has been a recurrence of the former symptoms. The eye prominence diminished for a time and again returned. Pulse 118 and irregular. There was tremor and some hoarseness.

In addition to the 121 patients, 3 others were traced but sufficient data to classify them were not obtained. Patients who are benefited, but not cured, by the removal of a part of the thyroid will in many instances improve greatly with a resection of the remaining part of the gland. This point has been demonstrated in 9 of our patients in whom the symptoms recurred and the second operation was done. Of these 9 patients, 4 were cured by the secondary resection; 1 was practically cured, though slight evidence of the disease remained; 2 were greatly improved. These results tend to bear out the impression that if the patients are not cured it is because enough of the gland has not been removed.

An effort has been made to determine the factors pertaining to exophthalmic goiter which would indicate the results from operative treatment that might be promised patients. In this, however, we have been only partially successful. In 8 of a group of 13 unsuccessful cases there was considerable dilatation of the heart at the time of operation, and several of the patients had developed œdema. A complete cure could not be expected in this type of case; nevertheless, in several instances great benefit was derived from the operation. Twenty-five of the 55 patients who were cured had some dilatation of the heart at the time of operation.

The oldest patient operated on (57 years of age) and the youngest (4 years and 2 months) were cured. The average age of the patients cured was 30.7 years; the average age of patients deriving little or no benefit was 29.1 years.

In the series of 121 patients traced, there were 107 females and 14 males. All but 2 of the males were benefited. The average length of time in which these patients had had symptoms before coming for treatment was about the same in the group of cured (19.3 months) as in the group receiving no benefit (22.2 months). The average length of time required to effect a cure was 17.9 months. In the second and third groups, in which were included the patients who were better but not cured, the average length of symptoms was longer: in Group II, 31.6 months; in Group III, 49.2 months. Despite the fact that the statistics do not emphasize this point, we believe that more cures and better results will be obtained in patients having symptoms for short periods than in those having symptoms for a number of years. The average duration of symptoms in patients who were cured was 19.3 months. It would seem reasonable to assume that if patients could have been treated within the first year a larger percentage would have been cured.

All of these patients had some degree of exophthalmos (Stellwag or von Graefe) before operation; many of them complained of pain and tension of the eyes which usually disappeared soon after operation. Often they stated that their eyes felt much better even before there was any appreciable change in the degree of prominence. From our observations it would seem that the exophthalmos is one of the last symptoms to subside; sometimes it persists long after all other evidence of the disease has cleared up. Seventy-five patients reported that all prominence of the eyes had disappeared or was greatly diminished.

The functional results in our cases have been very satisfactory. A low collar incision just above the clavicle reflecting the superficial tissue flaps, severing the muscles just below their upper attachment on either side, if necessary, is inconspicuous. This incision heals quickly and normal motion of the head and neck returns in a few weeks. In a small number of patients there has been some disturbance in the voice, though this has been temporary. It is apt to be most marked about the fourth or fifth day when the œdema is greatest. In one instance there was total loss of the voice for two months, when it rapidly returned to normal. The characteristic squeaky goiter voice so often heard in exophthalmic patients before operation usually completely changes to normal by the time the wound has healed. Some of our patients who speak with the normal motion of the vocal cords have complained of the voice being weak or tiring easily. At times it is husky, and there is difficulty in singing. All of these symptoms usually subside in a very short time.

Of the 176 patients operated on in 1909 (some had three operations), 21 died, 7 in the hospital. All of these were females; the oldest 46 years, the youngest 15. In 5 a single ligation only was done; in 2 there were resections. The average length of time symptoms had existed prior to operation was 29.5 months. One of the patients who died following resection had had a ligation and seemed entirely well. About five years after the ligations in our clinic, she had a hysterectomy performed elsewhere. Her goiter symptoms recurred, growing gradually worse, and she returned to us for resection.

The histories of the patients who died show that they were all operated on at the time of the maximum severity of the disease. If we had realized then as we do now the danger of operative interference at the height of any attack of hyperthyroidism, the patients might have been carried past the period of maximum severity before operating. In all of these patients hyperthyroidism was the clinical diagnosis of the cause of death; 4 showed dilated hearts and œdema. The average loss of weight of the 7 patients at the time of operation was 42 pounds. The average white blood count was 7,800, and the average lymphocyte count 49.3 per cent.

Fourteen patients have died since leaving the hospital; 1 ten months after a double ligation. This patient had a recurrence of the trouble; was operated on elsewhere and died. The average length of time between operation and death in these 14 patients was 14.1 months. In 11, ligations were done; in 2, resections; and in 1 there was a recurrence. The average age was 34.1 years. Eleven had dilated hearts; 4 systolic murmurs. There was œdema in 6 and evidence of nephritis in 4. From this review of the histories of patients who have died, it seems evident that the condition was extremely toxic. It is quite probable that most of them died because of continued intoxication which had produced irreparable damage, usually in the heart, liver, and kidneys.

Better judgment as to what should be done and when to do it has lowered the mortality considerably in the past five years. In the series of letters received from exophthalmic goiter patients during the past few months, eleven mention having borne healthy children since operation. One woman had had three children. In two pregnancies one patient had had a recurrence of all the symptoms of hyperthyroidism and, because of this, abortions had been performed. This patient's report did not make clear that she was really suffering from hyperthyroidism when pregnant. Her chief symptom was vomiting and this, of course, may have been the pernicious vomiting of pregnancy; however, she had had one normal pregnancy without serious vomiting, before her attack of hyperthyroidism. Eight of the women who have had children since operation have been classified in Group I, as cured; two of them in Group II, as improved; and one in Group III in which no benefit has been derived from operation.

Judging the results in this series of 121 patients, a cure may be expected in about 45 per cent. In addition to this, about 23 per cent will be practically cured, although a slight trace of the old trouble may persist. Our statistics show that an additional 4 per cent obtained some benefit. About 5 per cent reported that they had received no benefit.

PANCREATIC CYST AS A CAUSE OF UNILATERAL HÆMATURIA[1]

With Report of a Case

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THE report of a single case before a body, singly and collectively as experienced as the Southern Surgical Association, requires some justification. This I believe I can claim for the following report, because of an error in diagnosis, largely attributed to a symptom hitherto undescribed in connection with an abdominal growth, which in itself is rare; for cystic tumors of the pancreas are surely not common.

So far as I can now recall, I have had an opportunity of operating on only six cases. From the enormous material of the Mayo Clinic for the last two years one must conclude that pancreatic cysts are rare. Of a little over 5,000 abdominal operations performed in 1914, only two were for pancreatic cyst. Among 4,764 sections in 1913, there were none for pancreatic cyst, although in that year six cases were so diagnosticated.

In a very extensive review of the literature, I have found no other case in which, as the one to be presented, profuse hæmaturia was a cardinal symptom and led to an error in diagnosis.

W. L., aged 61, farmer, referred by Dr. Conard, of Blanchester, Ohio, to whom I am indebted for the history previous to the patient's admittance to the hospital. The father died at 70, of mastoid disease; mother at 60, of tuberculosis. One sister died of tuberculosis at 30, and one of pneumonia. One brother is living, age 50. The patient was always strong and well until three years ago. Habits excellent. The present illness began three years ago with violent abdominal pains in the region of the umbilicus. The pains lasted for five or six days, and disappeared after free catharsis. Their exact nature could not be determined. There was no elevation of temperature, no tenderness that could be particularly localized. During convalescence there was severe pain in the left arm and shoulder, which lasted for several days, but could not be explained.

A year ago the patient had a similar attack, from which he did not recover as promptly as from the first. He could not walk erect, there was tenderness on pressure in the left hypochondriac region and in the region of the left kidney, but no tumor mass could be felt at the time.

In June, Dr. Briggs recognized a tumor in the left upper quadrant. The patient has not been well since, but did not present himself for examination again until September 6, when he came on account of passing large quantities of blood with the urine. At this time he stated that he had had for a number of years pain on the left side under the ribs, and this was at times followed by the passing of bloody urine. During the last year the patient has lost over 30 pounds. He has coughed a great deal, and a single examination of the sputum showed the presence of tubercle bacilli.

Condition on admission to the Jewish Hospital, September 14, 1915: Well developed male, weighing 190 pounds, but evidently much reduced from his normal weight. Facial expression that of prolonged suffering. Pulse about 90. Systolic blood-pressure 110; temperature normal; hæmoglobin, 90 per cent; red count, 4,200,000; white, 8,700; polymorphonuclears, 74; mononuclears, 3; large lymphocytes, 7.4; small lymphocytes, 15; eosinophiles, 1.4. Urine dark in color, almost chocolate, contains a large amount of blood intimately mixed with the urine. No clots. Negative for bacilli. Stools normal in color and consistency. Negative for occult blood.

Physical examination. Percussion negative. Ausculation reveals course, moist râles over the greater part of the left lung, which accounts for the profuse expectoration. The sputum repeatedly examined for tubercle bacilli was negative, although the report of Professor Wooley states that almost everything else, streptococci, and staphylococci, diplococci and sarcinæ, were present. It is probable that the tubercle bacilli found on one previous examination before the patient's admission to the hospital came from the mouth or gums, which were in bad order, the latter being very much retracted. The X-ray of the chest was negative.

Abdomen. In the upper left quadrant a tumor nearly as large as an adult head is palpable. Viewed from the foot of the bed the upper half of the abdomen showed the tumor projecting in a graceful curve, the highest point of which is fully two inches above the general level of the integument. The lower abdomen shows nothing abnormal. Percussion over the growth elicits a flat note, which extends over the axillary line, and continues to the spine, except for a tympanitic band, descending from above and to the left of the median line, and evidently produced by the colon. There is a fullness in the left costo-iliac space. The tumor is distinctly fluctuating. The X-ray examination shows a normal shadow of

[1] Read before the Southern Surgical and Gynecological Association, Cincinnati, December 13–15, 1915.

the lower half of the right kidney. In the upper part of the abdomen there is a tumor shadow, which extends to the right of the median line and lifts the left half of the diaphragm. The colon filled with barium bovilac shows no deflection.

Cystoscopic examination. Bladder and ureteral orifices normal. From the left ureter there is a rhythmic expulsion of a bloody stream. On account of the exhausted condition of the patient ureteral catheterization was refrained from, and the injection of indigocarmin used. Within five minutes a nearly black stream was belched from the right ureter and one almost as dark from the left.

Clinical diagnosis. Cystic sarcoma of the left kidney without any question mark. Operation was performed September 17, 1915, under gas-ether anæsthesia. A left lumbar incision was made through costo-iliac interval, with easy exposure of the left kidney. When this was brought into the wound no trace of the tumor was found, although the kidney looked somewhat larger than normal, and darker in color. An incision through the peritoneum to the inner side of the colon permitted the palpation of a large retroperitoneal growth, which could be best reached from in front. The kidney being anchored, the incision over it was closed with layer sutures. Median incision first disclosed the spleen, which projected below the lower border of the ribs and measured approximately eight inches in both surface diameters. Its surface was dark purple. The sharp anterior edge overlapped the cystic growth, which it was now evident projected between the transverse colon and the greater curvature of the stomach. The diagnosis of pancreatic cyst was of course easily made, and after tapping and excision of a portion of the cyst wall, the remainder was attached to the abdominal wall. The operation was completed in the usual way of draining cysts of the pancreas. There were over 1,000 ccm. of the fluid removed. This was rather viscid, blood stained, and contained a large number of little yellowish masses, globular in shape, easily crushed, and looking not unlike miniature butter-balls. A few of these were adherent to the cyst walls. They consisted in fact of saponified fat.

The analysis of the fluid, made by Professor Reemelin, showed positive evidence of (1) alkaline proteinose, (2) amylose, and (3) lipose. Evidently, therefore, the digestive ferments found were of pancreatic origin. The cyst wall, according to the report of Professor Wooley, contained no pancreatic tissue. It is composed of a typical granulation tissue, of which there are very many polymorphous leucocytes, indicating that the cyst was of a chronic inflammatory character.

Subsequent history. The error in diagnosis evidently did not influence the post-operative course. The wound over the kidney healed by first intention. From the third day on the urine became less and less bloody, and after the end of the week had become clear and remained so to the end. The abdominal incision did not do so well, but for a period of three weeks gave us much concern on account of the irritation of the skin from the discharge, which is common after pancreatic drainage. Unfortunately, the pulmonary condition recognized before the operation was aggravated, and pneumonic patches developed first in the lower part of the right lung, and gradually extended upward. The profuseness of the expectoration suggested the possibility of a pulmonary abscess, although X-ray examination and very careful physical examination made by Dr. Rachford demonstrated only a progressing bronchopneumonia. To this the patient succumbed nearly seven weeks after the operation. The abdominal wall was almost completely closed and drainage so slight as to require dressing only every three or four days.

So far as my knowledge goes from a rather extensive study of relevant literature the case presented is unique in that renal hæmaturia was caused by a pancreatic cyst. It doubtless was the result of pressure on the left renal vein. A like pressure on the splenic vein, caused the enlargement of the spleen to four or five times its natural size.

It is clear to me now that an error in diagnosis might have been avoided by two methods of examination which were not practiced, because in my judgment there was a limit to the amount of investigation which the exhausted patient would tolerate.

Had we resorted to an X-ray plate of the stomach and colon simultaneously filled with barium, the relation of the tumor to the stomach and colon would certainly have been demonstrated. Again, an injection of collargol into the pelvis of the kidney would likewise in all probability have shown a normal renal pelvis, which does not go with tumors of the kidney, since it is quite certain that almost every growth of the kidney associated with hæmaturia can be recognized by the deformity which the collargol-distended pelvis reveals upon the radiogram.

Furthermore, the hæmaturia in the total absence of clots looked clinically more like that which attends an inflammatory condition than that associated with tumor of the kidney. It would have been better perhaps to drain the cyst from the wound in the loin, as has been done by Pierce Gould, and Johnston, but by the time the nature of the growth was made certain by the abdominal incision the posterior one had been definitely closed.

SALPINGITIS SECONDARY TO APPENDICITIS[1]

By JAMES E. MOORE, M.D., F.A.C.S., Minneapolis, Minnesota

THE writer's experience goes back to the time when we had perityphlitis, pelvic hæmatocele, and pelvic cellulitis. We first learned that perityphlitis was due to an infection in the appendix. We next learned that what was termed pelvic cellulitis was due to an infection, and some time later that the infection began in the fallopian tubes, and that whatever of pelvic cellulitis there was, was secondary to the tubal infection. And still later we learned that in the majority of instances pelvic hæmatocele is due to an ectopic pregnancy. It is now well established that infection of the fallopian tubes is the most common condition in the pelvis requiring surgical treatment. The entrance into the tubes from the uterine side is very small, and it would seem as if it were one of Nature's wise provisions to prevent the entrance of bacteria into the peritoneal cavity through the natural channels. On the contrary, the fimbriated extremity of the fallopian tube is wide open, and if any bacteria are present in the peritoneal cavity it would be very easy for them to gain entrance to the tube. The tubes normally are sterile, although occasionally they are found to contain bacteria without symptoms of infection. Under normal conditions the uterine end of the tubes are further protected by a sterile uterus, and they do not become infected until after an infection of the uterus. In other words, the tubes are not liable to infection from the uterine side except under abnormal conditions. Is it, therefore, not rational to conclude that when abnormal conditions obtain within the peritoneum that the tubes may be infected from the peritoneal end? When abscesses were first found within the tubes the contents were reported as sterile, but better technique has enabled us to demonstrate various forms of bacteria in these abscesses.

In 1886 Westermark first discovered the gonococcus in these abscesses. Following this discovery the profession went to the extreme, as it too often does, and many articles were written supporting the belief that all cases of salpingitis were due to the gonococcus infection. At the present time it is well established that while the majority of cases of salpingitis are due to a gonococcus infection, there are many due to infection from other bacteria. The bacillus coli has often been found in salpingitis and has been considered due to intestinal adhesions. Kelly says that bacteria may escape from the appendix and infect the tube, and quotes a case of Robb's in which one tube in a double pyosalpinx gave a negative culture and on the other side the tube was closely adherent to an inflamed appendix and contained streptococci. Salpingitis is often complicated by appendicitis. May not one be the cause of the other?

In a recent paper by Goldstine,[2] 328 cases of salpingitis are reported, of which 197 gave positive evidence of gonococci; 43 were of puerperal origin; and 86 from other sources. In 12 cases the appendix was firmly attached to the right tube and ovary, and in 5 of these the right tube only was involved, which would seem to be positive evidence that the tube was infected from the appendix.

A number of years ago the writer's attention was first called to the possibility of appendicitis being the cause of salpingitis by the following case:

A single woman, age 30, was brought from one of the smaller cities of Minnesota to Minneapolis for operation, with a diagnosis of salpingitis. She was taken to a gynecologist who firmly believed that the only cause of salpingitis was infection from the gonococcus, and in the absence of any evidence of infection in the vagina and the presence of an imperforate hymen concluded that it was impossible for the patient to have salpingitis, and discredited the attending physician's diagnosis. The patient was then brought to the writer, who found that the patient gave a history of repeated attacks of inflammation in the lower abdomen and pelvis, and by rectal examination a solid mass could be made out in the pelvis. The vagina was healthy and the hymen intact. There was no history of disease or

[2] Surg., Gynec., & Obst., 1915, xxi, 239.

[1] Read before the Southern Surgical and Gynecological Association, Cincinnati, December, 13–15, 1915.

unnatural discharges from the vagina at any time. The diagnosis of salpingitis was confirmed, although the possible cause was not understood. Operation was performed by the writer, who found evidences of repeated attacks of appendicitis, found the appendix closely adherent to the right ovary and tube, and both tubes distended with pus. The appendix and tubes were removed, and the patient fully restored to health. It is evident that the infection had not extended to the uterus, because it was left and has never caused symptoms. This led the writer to conclude that this was a case of salpingitis secondary to appendicitis.

This occurred many years ago at a time when facilities for careful bacteriologic examinations were not at hand, so that we had no means of knowing what bacteria were present. Since that time the writer has observed a number of cases that have confirmed his conviction that some cases of salpingitis are due to an infection from the peritoneal side caused by an appendicitis, but only two more cases will be cited to emphasize the point we are trying to make.

CASE 2. A woman 39 years of age had been married a number of years and had never conceived. She spoke a foreign tongue little used in this country and it was very difficult to get an accurate history, but we learned that she had had repeated attacks of abdominal inflammation which resulted in chronic invalidism. Upon entrance to the University Hospital a physical examination showed marked tenderness over the lower half of the abdomen particularly over the pelvis, and in the left pelvis a mass could be made out which was evidently an inflamed tube. A median incision was made and a large hydrosalpinx of the left tube removed. On the right side the ovary and two-thirds of the tube were absent. There were extensive adhesions and the appendix, which had undergone many changes from inflammation and was tightly bound down, was removed. This woman had had no previous operations, but owing to our inability to talk with her we were unable to get a satisfactory history of an abscess having discharged through the bowel. Yet it seems to me that the only way that the absence of this right ovary and tube can be accounted for is that there has been an inflammation beginning in the appendix and extending to the right tube and ovary, which ended in extensive abscess and sloughing, and was all discharged through the bowel. The uterus did not seem to be enlarged or infected, but was retroverted and was fastened forward by the use of the round ligaments.

CASE 3. A trained nurse, aged 23, was admitted to the University Hospital July 10, 1915, complaining of pain in the pelvis and right lower abdomen. She had a temperature of 102.5°, leucocytes 22,900, polymorphonuclears 84 per cent. Upon physical examination there was marked tenderness over the lower abdomen and pelvis, but no muscular rigidity. Deep pressure over the right iliac region together with pressure in the loin elicited severe pain. This was the location of her severest pain. Upon vaginal examination the uterus was found freely movable and not sensitive. The right tube was distended but floating freely, and was not particularly sensitive. It was decided that the pelvic condition did not account for the temperature and blood picture, and from the pain elicited by pressure over the right loin and right lower quadrant of the abdomen a diagnosis was made of acute retrocæcal appendicitis. This diagnosis was based upon the location of the pain and tenderness and the absence of muscular rigidity. An incision was made and the appendix found behind the cæcum and extraperitoneal with the exception of a very small portion of its tip. It was dissected out and removed, and upon section proved to be full of pus. The patient gave a history of having had like attacks before and there were many adhesions, showing there had been a previous appendicitis. The right tube could be felt quite markedly distended but freely movable. The left tube was normal. The distended tube was not removed, and the abdomen was closed. By midnight her temperature had dropped to 100°, and the next morning was 99°. Leucocytes and polymorphonuclears dropped promptly and were gradually reduced to normal. After this time the temperature ranged from normal to 101°, most of the time being in the neighborhood of 99°, which could be accounted for from her salpingitis. On the fourteenth day after the operation she was allowed to sit up and her temperature immediately rose to 102°, with return of pain in the pelvis. This again disappeared when she was put to bed. On August 21, she had been sitting up some days with comfort and was allowed to go home with a temperature of 99°. In other words, her convalescence gave a picture of a convalescing subacute salpingitis. There was no history of vaginal infection, and smears were negative. It seems to the writer that the only rational conclusion to be arrived at in this case is that this woman had appendicitis which infected the right tube. The left tube, it will be remembered, was normal.

We believe that these cases demonstrate that infection of the fallopian tube may occur from the peritoneal end, and that when it does it is usually due to appendicitis. We believe that it should be accepted as an established fact that a certain small percentage of cases of salpingitis are due to appendicitis, so that when looking for possible causes of a pelvic inflammation we may take this fact into consideration.

ULCER OF THE JEJUNUM

With Report of a Case[1]

By ROBERT C. BRYAN, M.D., F.A.C.S., Richmond, Virginia

VAN ROOJEN has been able to collect from literature three cases of apparently undoubted peptic ulcers of the jejunum in whom no previous gastro-enterostomy had been performed. He says: "The jejunal peptic ulcer is one which manifests itself in its outer appearance, its symptoms, as well as results, analogously to the peptic ulcer of the stomach, with the difference that while no tangible cause can as a rule be attributed for the development of the gastric variety of this ulcer, the jejunal is practically always a sequela of an antecedent gastro-enterostomy. I say practically always, in the literature on the subject, this relationship is considered a constant one. I know, however, of three cases of jejunal ulcer where no antecedent gastro-enterostomy was performed." In 1861, that is 20 years before the first gastro-enterostomy was performed, Wagner reported such a case. Professor Rotgans while performing a gastro-enterostomy for a peptic ulcer of the stomach, discovered during the operation, a peptic ulcer of the upper part of the jejunum. Dr. Schoo, the pathologist at the Wilhelmina Hospital at Amsterdam, informed Van Roojen of having found two such spontaneous ulcers of the jejunum at autopsy.

That anatomic deviations and anomalies may be found in the upper abdomen, is frequently observed. Normally the duodenum and the jejunum are continuous but the following differences may be noted: In the duodenum the glands of Brunner are found which penetrate the muscularis mucosa, their fundi lying in the submucosa. These glands are not found in the jejunum or in the ileum. They manufacture an alkaline juice which, with the glands of Lieberkuhn that are found in the duodenum, along with the product of the pancreas, produces the succus entericus. The muscular coat of the duodenum is thicker than that of the jejunum and the normal habitat of germs is also different in these two segments of the gut. The most striking anatomical variation is the fixed position of the duodenum with its anterior mesentery and generous blood supply. The thin jejunum, on the other hand, enjoys a large excursion, being fixed only at its proximal end. Its minimum mobility is therefore greater than the maximum of the duodenum. It has a complete mesentery and is swung vertically.

The case to be reported is W. H. M., age 48, white, inspector. Family history negative, but for one sister who died of cancer. Father alive at 80. Usual mild diseases of childhood.

He had typhoid fever 25 years ago and was confined to his bed several months. He was operated on for mastoiditis 23 years ago in New York and has had continuous rubber drainage ever since, and is entirely deaf on the left side. His leg was broken 15 years ago; good result. He had measles 6 years ago and was very ill but there were no complications. He never drank or used tobacco. In the last four years he has had severe attacks of indigestion with increasing frequency of late, characterized by violent cramps in the region of the stomach. He has always been a hearty eater and chronically constipated. Two years ago he had constant pain and nausea which continued for four months. He vomited constantly but he never noticed any blood in the vomitus. He then consulted a physician who said he had an ulcer of the stomach. He was now thoroughly incapacitated for work of any kind and lost considerable weight and strength. At this time he started washing out the stomach which always made him feel better. The washings were green with yellow mucus. The pain would come on from two and one-half to three hours after eating. Recently, in the last few months, there had been persistent pain and nausea, but no vomiting, although there was a constant desire to eat or drink something, and he had noticed that he could not eat very much at a given time. For several years he had used strong liniments on the pit of his stomach. This, with a hot water bottle, was his accustomed treatment. He did not believe in medicines and would not take them. The patient had been unable to do any regular work in the past three years, and consulted many physicians, who said he had cancer of the stomach, spasm of the pylorus, appendicitis, and ulcer of the stomach.

September 8, 1915, at 1 a.m. while employed

[1] Read before the Southern Surgical and Gynecological Association Cincinnati December 13–15, 1915.

as an inspector in a munition factory, he was suddenly seized with a most agonizing pain in the abdomen and groins. This pain was unlike any that he had ever had before. He was found about an hour later by some of his fellow workmen in a collapsed condition, and brought to Grace Hospital at 3 a.m. two hours after the sudden seizure.

When seen by the writer at 8 a.m. the patient was fairly comfortable, the pain had been controlled by morphine, the face was drawn and pale, and the extremities cold, pulse 104, temperature 96, respiration 22. There was persistent nausea and frequent attempts to vomit, but nothing came up. An insatiable thirst was very distressing. The abdomen was board hard. There was no area of tenderness greater than another, a most annoying and painful priapism persisted throughout the day. The catheter gave two ounces of urine which was acid, 1,030, moderate amount of albumin, occasional red blood-cell, no pus, few hyaline and several fine granular casts; phosphates normal, no sugar, no chlorides; indican, acetone, diazo and urobilinogen negative. White blood-cell count 8,400. Liver dullness absent, heart sounds distant but clear. Respiration shallow. The picture was that of acute abdomen and the diagnosis of probable perforation of ulcer of the stomach was made.

The patient positively refused operation and only consented at 8 p.m., 17 hours after the onset, with temperature 101°, pulse 114 and respiration 38.

Ether anæsthesia, right rectus incision. The peritoneal cavity was full of greenish fluid with flakes of lymph and food-particles floating about in it. The stomach was atrophic, hard, bound down, pulled to the left and firm, the walls white and heavy, the omentum shrunken and thick. The duodenum was plastered down, the jejunal wall was likewise indurated, whitish and thickened, and on its anterior wall about three inches from the duodenojejunal juncture, a round punched-out ulcer, the size of a cherry stone, was found. The induration of the jejunum extended several inches below the point of perforation, and tapered off gradually in the jejunal wall. The patient's condition was desperate, on account of the great thickening, diminished lumen, and fixed position of the stomach, duodenum and jejunum, no anastomosis could be made, purse-string and invagination were impossible. A piece of omentum was plugged into the opening and several retaining catgut sutures sewed over it, the belly was irrigated with warm saline. A large drainage tube was inserted and a stab wound made into the pelvis. The patient died the next morning at 10 o'clock. Autopsy was refused.

JEJUNAL ULCER FOLLOWING GASTRO-ENTEROSTOMY

In 1899 Braun first described this complication and although the subject has since received considerable attention in Germany by Hahn, Kausch, Schwarz, and Korte, Keen's case in 1904 was the first described in English records. Mikulicz, Pinner, Tiegel, Mayo-Robson, von Haberer, Van Roojen, Paterson in his Hunterian lectures, and Gosset, contributed the early literature on this topic. Extremely interesting experimental studies have also been carried out by Exalto, Katsenstein, Hotz, Kathe and Wullenstein, and more recently by Soresi of New York.

FREQUENCY

Statistics show that jejunal ulceration occurs in 1.5 per cent of all gastro-enterostomies. Keen states that all of these cases were of the perforating character, and therefore were not recognized, causing death by abscess, or in other ways in which adhesions and complications so obscured the parts that even an autopsy failed to reveal the true nature of the disease.

Mikulicz says that in 34 instances in which the location of the gastro-enterostomy anastomosis was mentioned, 25 times it occurred in the anterior and 6 times by the posterior method. In the posterior operations the jejunal opening is about 9 inches distant from the beginning of the jejunum; in the anterior it is from 16 to 20 inches distant from this point. It would appear, therefore, that the lower the point of anastomosis in the jejunum, the more susceptible the musoca to the digestive action of the peptic juices.

1. The ulcer developed rapidly and perforated shortly after operation.

2. The ulcer developed in a few weeks or a month after operation, suggesting a recurrence of the former trouble.

3. The ulcer developed slowly and insidiously, undergoing a subacute perforation.

4. The ulcer perforated into a hollow viscus.

ETIOLOGY

That ulcers of the intestine frequently occur has been well established. Most of them are superficial, heal spontaneously and consequently possess no surgical interest. As a rule they are merely the expression of a

general disease such as gout, syphilis, scurvy, anthrax, leprosy, tuberculosis, dysentery or erysipelas. Any form of intestinal ulcer may lead to perforation. The duodenal perforation following extensive burns has been frequently recorded.

Age. The age in jejunal ulcers following gastro-enterostomy does not seem to play an important rôle. Of the 146 cases collected by Schwarz in 1914, the youngest patient was 2 months old, while the oldest had reached the age of 70. The disease occurred most frequently between the ages of 30 and 50.

Sex. It has been supposed that the predisposition of the male is perhaps due to the fact that men are most apt to be indiscreet about eating and drinking, especially alcoholic indulgences, and that their greater participation in the more strenuous demands of life likewise predispose them to this affection. Pinner would add to this excessive smoking.

Time. The jejunal ulcer develops most frequently within the first six months following the original gastro-enterostomy. Of the 146 cases above referred to, 50 developed within this period, 22 within the second half year, 23 within the second year, 20 between the second and fifth years, and 13 between the fifth and tenth years. According to Pearson, rough handling, marginal bruising, and excessive dragging on the parts, the use of blunt instruments in effecting the opening into the stomach and bowel, and the injudicious tight application of clamps and forceps, hæmatoma, emboli, tension-traction, are the factors following gastro-enterostomy which do the mischief.

Next in importance is sepsis, either as the result of infection at the time of the operation or already existing in the diseased stomach. Insufficient blood supply resulting either from excessive tension of the sutures, or due to thrombosis in the vessels around the anastomotic opening.

The presence of a foreign body is a frequent cause according to Pearson of the gastrojejunal variety of this complication, and the most frequent foreign body, as well as the most frequent source of irritation, is the prolonged retention of an unabsorbable inner suture.

Paterson offers the three following suggestions as the cause of jejunal ulcerations:

1. That jejunal ulceration is due to circulatory disturbances in the attached jejunum.

2. That jejunal ulcer is an infective process.

3. That jejunal ulcer is due to the digestive action of gastric juice on mucous membrane accustomed to the presence of alkaline contents only. Paterson holds to the view that such ulcerations are toxic in origin and states that "this toxic agent usually present is hydrochloric acid, but that other toxic agents may possibly be present and either may increase the effect of the other."

Thus a small percentage of free hydrochloric acid in the jejunum which by itself would not cause ulceration, in the presence of some other toxic agent, might produce ulceration. The circumstances under which free hydrochloric acid may be present in the jejunum are—

1. Hyperacidity of the gastric juice so that the bile and pancreatic juice are unable to neutralize completely all the acid entering the jejunum.

2. Normal percentage of hydrochloric acid in the gastric juice but excessive secretion, so that the amount of hydrochloric acid discharged into the jejunum is greater than can be neutralized.

3. Diversion of the course of the bile and pancreatic juice so that the jejunum is exposed to the action of gastric fluids unmixed with the bile and pancreatic juice, as in certain operations.

4. Normal acidity and normal amount of gastric secretion but incomplete neutralization in the jejunum, owing to temporary diminution of the flow of the bile and of the secretion of the pancreatic juice.

Moynihan is inclined to the idea that jejunal ulcers are always secondary to an infective process elsewhere, most likely in the abdomen.

Pinner in commenting upon the reported cases doubts from the available anatomical description if they were actually peptic ulcers.

From time to time various theories based

upon anatomical, clinical, and experimental considerations have been brought out, but ever since Tiegel expressed in 1904 his belief that the chief cause of these ulcers following gastro-enterostomy is to be found in the deleterious effect of the acid gastric juice upon the mucosa of the jejunum, a tissue not accustomed under normal conditions to this chemical agent, all authorities are inclined to concur in this opinion. Despite the fact that not an inconsiderable number of cases have been reported in which the hydrochloric acid content of the gastric juice was normal or even subnormal.

Keen thinks that a mild form of sepsis leading to an excess of free hydrochloric acid in the gastric juice, traumatism either by coarse food or through external injury, and interference with the circulation in the bowel, must be considered as possible causes.

Von Bergmann states that if the gastric juices pass directly into the jejunum, a typical gastric ulcer may be produced, the gastric juice being found to contain excess acid.

Oviatt, in the *American Practice of Surgery*, declares that ulcer of the jejunum has never been found following operation for pyloroplasty or gastroduodenostomy. In pyloroplasty and gastroduodenostomy the acid secretion is neutralized by mixing with the bile, pancreatic juice, and succus entericus. Mikulicz reports a case of a child three months old in whom an ulcer formed following an operation for congenital stenosis of the pylorus. H. J. Paterson states that in most instances, hyperchlorhydria is due to the insufficient use or inefficient working of the anatomic opening, also that arteriosclerosis of the blood-vessels of the mesentery, or kinking of these structures may interfere with the blood supply and so predispose to the formation of ulcer.

The above are some of the theoretical explanations of a condition which to the writer is apparently directly contingent upon an acid autodigestion, for ulceration lower down in the alimentary tube, following an entero-enterostomy or enterocolostomy is unknown; in other words the acid chyme of the stomach is done away with in these anastomoses, as only alkaline products are found from the pyloric ring to the rectum.

EXPERIMENTAL

The theory of hyperacidulation is supported if not in its entirety, certainly to a very large extent, by some of the foremost surgeons. Schwarz dismisses the etiologic consideration with the terse sentence: "Where the gastric juice has no access, there is no peptic ulcer." It is further confirmed by some of the experimental work carried out by Katsenstein, Wullenstein and Kathe, who sutured into the stomach of the dog, loops of intestines, and parts of other organs and observed the deleterious effects of the gastric juice upon the living non-stomach tissue of this animal. They assume that the stomach mucosa secretes a neutralizing antiferment which renders this tissue immune to the effects of the gastric juice.

Katz and Exalto carried out similar experiments and came to the conclusion that the disintegrating effects observed by the former investigators were due to interference with the blood supply of the invaginated part, and that whenever sufficient precautions were taken to avoid circulatory disturbance, no digestive effects were observed. Whatever their experimental studies may mean, certain it is, that the clinical facts point strongly to the correctness of the hydrochloric acid theory, for the complication follows much less frequently those operations which do not prevent the neutralizing alkaline fluids of the gall-bladder and pancreas from reaching the gastric juice and becoming mixed with it; in short, those operations which do not deprive the patient of this "inner drug-shop" as Roux aptly termed it.

Axel Key[1] records but one case of ulceration of the jejunum following gastro-enterostomy for carcinoma of the stomach. Rowlands was unable to find any such case. This apparently corroborates strongly the acid theory of jejunal ulcer formation.

Wilkie in 1910 performed gastro-enterostomies of different types upon a number of cats, and later administered to these animals hydrochloric acid in various amounts

[1] Nord. med. Ark., 1907, xl, 97.

and noted the effect of this upon the subsequent development of jejunal ulcer.

Exalto performed gastro-enterostomies in two series of dogs, seven in each series. In the first series he performed the ordinary anterior and posterior retrocolic gastro-enterostomies, while in the second series he used Roux's operation, in some anteriorly and in others posteriorly.

The dogs of the first series after uneventful recoveries from the operation, showed no subsequent involvement of the intestines, and in three of those who were killed, the autopsies showed no signs of ulcer formation in the jejunum. On the other hand, of the seven dogs in the second series, five died of a perforative peritonitis due to a jejunal ulcer, and of the two others who were sacrificed only one was free from this complication.

It is rather interesting to note that in the specimens photographed and fully described of the jejunal ulcer following gastro-enterostomy which the writer has seen, the necrosed area was located opposite to the new hiatus or in other words, in the direction of the flow of the gastric contents.

LOCATION OF DUODENAL ULCERS

Moynihan divides the stomach from the duodenum by that important land mark, the pyloric vein. He says "it runs generally a little to the gastric side of the pylorus, is constant and its recognition allows one to see instantly where the stomach ends and the duodenum begins. It runs upward from the greater curvature, is thick and short. If this landmark be taken as the beginning of the duodenum, 95 per cent of the total number of cases of ulcer lie within the first portion of the gut; that is, within one and one-half inches of the pylorus."

Eustermann says that the average ratio of gastric to duodenal ulcers is about 1 to 3; that is, 75 per cent of all ulcers are duodenal. Of 814 cases of duodenal ulcer, 77 per cent were in males and 23 per cent in females. Wilkie has explained this on an anatomic basis.

In Collin's series there were in the 262 cases, 242 in the first part; 14 in the second; 3 in the third, and 3 in the fourth.

Fig. 1. Stomach shows great thickening, walls white and heavy, organ markedly contracted and bound down to the left of the median line.

In Perry and Shaw's series of 149 cases, there were 123 ulcers in the first part of the duodenum, 16 in the second, and 2 in the third and fourth. In 8 instances the ulcers were scattered.

Moynihan says: "The first part of the duodenum is especially prone to attack. It may be that against it the jet of chyme directly impinges as it is expelled through the pylorus." In other words, after the neutralizing effect of the duodenal and pancreatic juice have become evident there is no ulcer formation.

Theoretically then, if a severe acid chyme, not enjoying the beneficent effects of alkalinization, would be hurriedly emptied through the duodenum into the jejunum, it would appear from a review of the literature and experimental work, that ulcer of the jejunum by this autodigestive process should take place. It has therefore occurred to the writer that the explanation of this necrosis rests not so much with an actual hyper-, acidity, as it does with a prolonged and intermittent failure of proper alkalinization by the normal ferments which should be found present in the duodenum. A transient cholæmia, interstitial pancreatitis or duo-

denitis, constitutional diseases, psychic, neurotic or hysterical influences may lessen or inhibit this alkaline product and thus permit the acid fluid to reach the jejunal membrane uncontrolled or modified by alkaline juices. Ulcus jejuni would be all the more likely with this state of affairs, if associated with duodenal abnormalities such as shortening, anomalous blood supply and an early or mesial duodenojejunal junction.

The writer's case of jejunal ulcer, was associated with the pathological states of the stomach, duodenum and jejunum already mentioned, apparently a cirrhosis of the stomach, linitis plastica, or the gastro-intestinal sclerostenosis of Krompecher.

In 1850 Gluege of Germany first described a case of complete cirrhosis of the stomach. Brant tells us of a case in which the lesion was found in the stomach and cæcum. By these authors the disease was held to be benign. Krompecher holds that gastro-intestinal sclerostenosis is not a mere disease of the pylorus, but is found in the intestines and peritoneum, and that it is the result of a chronic venous œdema, caused by cardiac insufficiency and arteriosclerosis and that the pathological process bears a close relation to scleroderma.

Brinton states that with the great thickness, the mucosa is often normal in appearance "the secretory structures remaining substantially healthy."

Lyle in his article "Linitis Plastica" states: "In the majority of cases, evidences of an associated subacute or chronic peritonitis are prominent, lymph on the coils of the intestines, fibrous adhesions, ascites, thickening and opacities of the lesser and greater omentum, white, waxy-like plaques on the visceral and parietal peritoneum with thickening of the retroperitoneal tissue" (the retroperitoneal callus of Hanot and Gombault).

From the hurried operation and great haste made necessary by the condition of the patient, the writer would not care to venture an opinion whether this was a case of linitis plastica with a coincident jejunal ulceration, or whether it was primarily an ulcer formation with perforation, associated with many other old healed ulcers in the duodenum and stomach resulting in great induration and thickening. The latter is probably the most tenable.

DIAGNOSIS

There being no literature upon diagnosis our investigations must be limited to, or deduced from, jejunal ulcers developing after a previous gastro-enterostomy.

Mayo-Robson says:

> If, after a period of good health subsequent to the operation of gastro-enterostomy, a patient begins to complain of acidity, flatulence, and discomfort after meals, followed after a time by definite pains from an hour to two or three hours after food, and relieved temporarily after taking milk or some other light diet, or some form of alkali; if the pain occurs on the left side of the umbilicus and is associated with marked tenderness and rigidity of the left rectus, the suspicion of ulcer of the jejunum will arise. Hæmatemesis or melæna or even the presence of occult blood in the fæces will make the diagnosis fairly certain, but if with all these symptoms a swollen and tender loop of bowel can be felt in the region of the anastomosis or below and to the left of the umbilicus, the surgeon can no longer be in doubt as to the nature of the disorder.

Pearson, from whom we quote liberally, says:

> Epigastric pain is the most constant symptom. Usually it bears no relation to the taking of food but is dull, aching, or stabbing in character and more or less persistent. In some instances, however, it closely simulates the periodicity of ulcer pains, a meal affording initial relief followed after a definite interval of exacerbation. The pain is usually in the middle line or slightly to the left and above the umbilicus and might strike through to the back when most acute. Epigastric distress, fullness, flatulence and eructations of sour gas with acid fluid may occur. Vomiting is not frequent, hæmatemesis and melæna are rare. Loss of weight will probably be observed, especially if the patient has enjoyed a period of good health before the onset of symptoms. Next to pain, epigastric tenderness is probably the most common sign. It closely corresponds in position to the pain, being more commonly to the left of the median line. A variable degree of muscular rigidity may be present.

Another objective sign upon which very much stress is placed by Barsony in the *Wiener klinische Wochenschrift*, 1914, is furnished by the roentgenologic examination of the jejunum. He believes, that an intense, spotlike shadow, which breaks through the filling in the jejunum and partly extends over

Fig. 2. Jejunum greatly indurated, the mesentery shrunken, its walls white and hard. Perforation shows about 3 inches from the duodenojejunal juncture.

the contour of this viscus, which furthermore remains uninfluenced by lavage, and the locality of which is tender to pressure, is characteristic of post-operative jejunal ulcer.

But these are the diagnostic measures worked out for that variety of jejunal ulcers which follow gastro-enterostomy.

With necrosis and mural disintegration the degree of pain is accurately adjusted to the proximity of the pathological process to the peritoneal investment, the writer would venture to state that in ulceration of the duodenum there is more pain and a longer course with the ulcer in the anterior or peritoneal wall than obtains upon the posterior or uncovered wall. This pain is aggravated by functional activity and, according to experiments, by the presence of hydrochloric acid. On the other hand it is controlled by rest and alkalines. This pain is to the left of the median line, at times referred to the back, is more localized in the upper abdomen and like most pain in the small intestines, is temporarily bettered by a gentle pressure. It may radiate to the groins along the spinal column, toward each renal fossa; in short assumes the varied characteristics of location or intensity of the pain of a localized inflammation of the small intestines, which is constantly referred in its

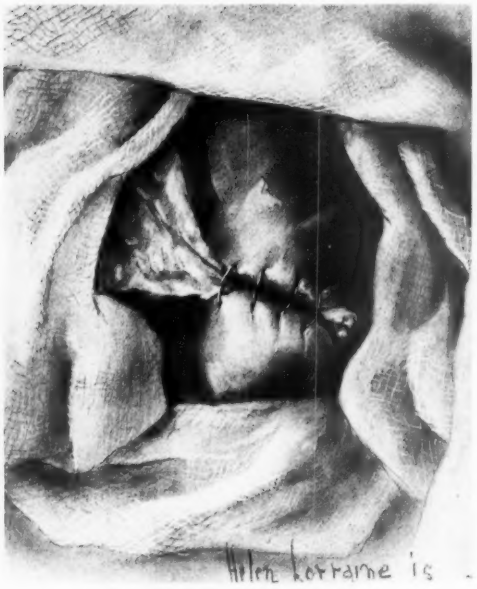

Fig. 3. Illustrates a tab of omentum packed into the opening and secured by some retained catgut sutures.

early development to an area about the umbilicus. This intermittent distress, whether it be the gone, empty, hunger pain of auto-acid digestion or the severe colicky pain of peritonism, should not be immediately benefited by an intake of alkalies and food, as is evidenced in cases of ulcer of the stomach and first part of the duodenum, as the food and drugs have some distance to traverse before finding the ulcerated area.

Nor is the gastric finding significant of ulcer of the stomach or duodenum. Vomiting with melæna is the rule, but hæmatemesis with melæna should not obtain. The history, blood count, urinary findings, and emaciation should also follow the course of ulcer of the stomach and duodenum.

The writer's experience in surgery of the stomach and with one case of ulcer of the jejunum, hardly justifies the presentation of a symposium of classical features which may be dignified with the title, "Diagnosis of Ulcer of the Jejunum."

TREATMENT

Keen states that if more attention were to be given to oral sepsis and to the gastric condition of hyperchlorhydria that relapse of ulcer might be prevented.

Apparently ulcer of the jejunum is found associated with other pathological states of the upper alimentary tract. Since so little is known and understood about primary ulcer of the jejunum, it may be stated that these associated conditions should be more readily translated and diagnosed by the routine laboratory procedures, and when so worked out and accounted for, the remaining untoward expressions may be laid at the door of a suspected ulcer of the jejunum.

Gastro-enterostomy being one of the causes of jejunal ulceration one should hesitate to perform the operation for primary ulcer of the jejunum. In appropriate cases excision, resection, or enterectomy are apparently the operations of choice.

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FRACTURE OF THE NECK OF THE FEMUR[1]

A Study of the Treatment and End-Results in Fifty-five Cases

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THE system of arches formed by the bone plates in the cancellous tissue of the neck of the femur, makes an ideal arrangement for lightness of construction with a maximum of weight-bearing capacity. The interaction of the arches one on another is necessary for carrying the weight of the body and the strain of its movements in the erect posture. When the neck of the femur is broken, this mutual relation is disrupted, and unless the arches are restored, in the process of healing, either the neck will bend at the site of union of the fragments or a greatly increased mass of bone must be formed to provide rigidity. Either alternative results in a permanent deformity.

Therefore, accurate apposition of the fragments becomes an essential in the treatment of this fracture, and sufficient time must be allowed for complete bone regeneration before weight is put on the united fracture if deformity is to be avoided.

The position of the separated fragments in the fracture is as follows: The shaft fragment is drawn up above and behind the head fragment, the trochanter is rotated backward carrying the foot into eversion, the lower end of the femur is drawn toward the middle line by the adductors. The head remains fixed in the acetabulum and the broken end of this fragment is directed upward and slightly forward.

In almost every case some portion of the periosteum remains attached to both fragments, and when the fracture is in a suitable position on the neck a portion of the capsular ligament is likely to bridge the separation of the bone.

The positions described give the general direction of the fragments, the relative positions of which vary in degree with the seat of the fracture. Several classifications have been advised to separate these fractures into groups according to the position of the break. Kocher's classification into subcapital, fracture at the junction of the head and neck; intertrochanteric, along the line between the trochanters; and pertrochanteric, obliquely through the trochanters; is used in our hospital records.

The blood supply of the neck of the femur is peculiar and the effect of a fracture on the circulation of the head fragment is an important factor in the healing of this lesion.

Lexer's[2] study of the circulation in bones shows that the blood supply to the neck of the femur enters from four points. The first, an epiphyseal artery at the insertion of the ligamentum teres, a second just at the line of junction of the head and neck on the upper surface, a third near the great trochanter, and a fourth, the largest of the group, a metaphyseal artery near the lesser torchanter. Lexer states that the blood supply is greatest in childhood and that in adult life the most marked change is seen in the diaphyseal group of arteries supplying the shaft, which become smaller and smaller with advancing age. The narrowing of the other two groups in the region of the epiphysis is less distinct, while the arterial supply of the joint apparatus becomes much more marked.

All these arteries reach the bone by way of the periosteum and the capsule. The importance of any attached and untorn area of these membranes is at once apparent. The fracture must have a profound effect on the circulation of the head fragment, because whenever this fragment is exposed at operation for non-union, the blood supply is diminished in proportion as the seat of fracture approaches the subcapital type.

Here again accurate approximation offers the best chance for good union, diminishing the need for new-bone formation, and giving the best opportunity for improvement in the local circulation.

[2] Arch. f. klin. Chir., 1904, lxxiii, 481.

[1] Read before the Southern Surgical and Gynecological Association, Cincinnati, December 13–15, 1915.

Fig. 1. Ice-tongs extension. Shows the bandaged leg, and the ice-tongs covered in by the gauze dressing. The small board between the handles assists in maintaining inward rotation.

Reduction of this fracture is accomplished by downward traction and internal rotation of the femur with the limb slightly flexed and widely abducted. The method of reduction and of fixation varies, with several authorities, but the essential principle is expressed above and has for its object the complete correction of the deformity caused by the position of the fragments.

Bardenhauer obtains gradual reduction by weight traction acting simultaneously in several directions. Slightly modified, this is the method of Maxwell and Ruth. Whitman reduces the fracture by manipulation under anæsthesia, using the completely abducted sound hip as a lever for fixing the pelvis. While forcibly carrying the fractured limb to the limit of abduction he presses down on the trochanter and at the same time lifts it forward, so as to overcome the external rotation. Both hips are slightly flexed in wide abduction and a plaster cast is applied from the toes to the nipple line on the injured side and a short distance on the sound

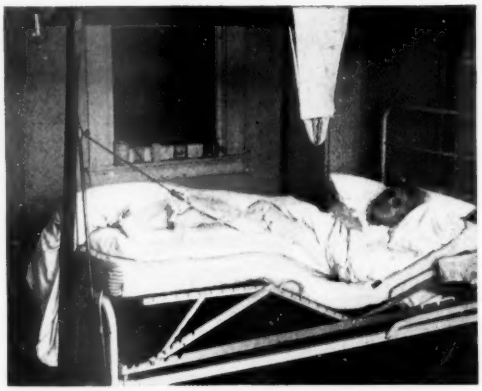

Fig. 2. Ice-tongs extension. Shows the position of the patient on the Gatch bed, and the overhead beam with its soft bandage, by means of which the patient shifts her position (Case 29).

side in order to securely fix the pelvis. A pad is placed behind the trochanter to support it and thus secure inward rotation.

Much criticism has been made of Whiteman's forced abduction, and the method has been condemned on the ground that the wide abduction is not required for all types of these fractures and that overabduction would lead to malposition of the fragments. We have demonstrated at operation, with the fracture open, and on a postmortem specimen, that abduction is essential to apposition and that after this point has been reached further abduction does not disarrange the fragments, because the taut capsule and other soft parts carry both fragments together to the limit of movement. This is an important point, because while it is almost impossible to calculate the exact degree of abduction that will give the best apposition in any particular fracture, the knowledge that complete abduction will surely carry the fragments out together gives us a definite position in which to fix the injured limb.

Impaction is most often a penetration with crushing and little fixation. Except in the rarest of cases the bones are driven into one another with adduction of the limb. Union in this position therefore gives great deformity and is the cause of most of the disability incident to fracture of the neck of the femur.

Fig. 3. Tying out. Showing both knees made fast to the board spreader, after abduction. Fracture on the left side. The spreader also prevents rotation of the bandaged thighs.

Fig. 4. Tying out. View from the side. Note the sand bag under the trochanter, correcting the outward rotation of the femur. The position of the foot is due to eversion below the knee. The cords fixing the spreader to the bed rail, and the pillows on the outrigger, under the foot, have been removed, in order to make the picture clearer. (Photographs by Dr. E. I. Bartlett.)

There is no doubt of this being the case in those individuals who are incapacitated although their fracture has united. Therefore impaction should be broken up by a gentle hinge like motion and the fragments be brought into apposition in abduction whenever there is hope of treating the patient.

The cases [1] now being reported were all treated on this general plan, but with several modifications of the details both as to reduction and fixation. The modifications may be grouped into six classes and in this way the cases will be reported.

Class A. Reduction under anæsthesia, fixation in abduction by means of lateral wire splints and interrupted plaster bandages.

Two mattresses are placed on the bed over a special frame of slats to give rigidity. This frame should extend beyond the bed on either side, or a single bar about six feet long may be placed transverse to the long axis of the bed near the foot. To this the legs are bandaged to keep up the abduction. A bar placed between the knees fulfils the same purpose.

The first dressing is removed at the end of two weeks, and subsequent dressings are made weekly. The knee on the sound side is left free at the end of two weeks, the sound leg at six weeks. In from seven to ten weeks all dressings are removed and the patient kept on crutches for at least three months longer.

This was our original fixation. In this way we treated five cases, three women and two men.

Class B. Reduction under anæsthesia, fixation in heavy plaster-of-Paris cast, extending from toe to nipple line on the fractured side and taking in the sound thigh for a short distance.

Twenty patients were treated by this method; ten women, nine men, and one boy sixteen years of age.

Class C. Adhesive plaster traction in two directions (abduction and inward rotation). Two patients were treated by this method, both fat women severely handicapped.

Class D. Direct traction by means of ice-tongs. This method was suggested to me by Dr. Ransohoff at the meeting of this society two years ago. It has been used in three cases. In one case an impaction was separated under anæsthesia preliminary to the traction. The ice-tongs are clamped into the femur through a small wound on either side just above the condyles, and are held in place by a sterile roll of gauze which, winding around the thigh and the blades of the tongs, makes the dressing for the wounds. The

[1] This paper is based on a study of 55 cases of fracture of the neck of the femur observed in St. Agnes' and Mercy Hospitals, Baltimore. Of the former group ten were under the care of Dr. Bloodgood or were put up by the Resident Surgeons, all however at some time in the course of their treatment came under my personal observation. Of the latter group, those cases occurring previous to 1913 were treated by me as Associate Surgeon on the service of Dr. C. F. Bevan. The later cases came to me when I succeeded him as chief of this service.

RECENT FRACTURES

Number	Date of Injury	Age	Sex	Occupation	Position of Fracture	Fixation	Anæsthetic	Immediate Result	Time in Bed	Period of Complete Disability	Period of Partial Disability
1	Mar., 1907	67	M.	Hotel Mgr.	Intertrochanteric	A	Ether	Union	63 days	77 days	3 mos.
2	Aug., 1907	71	F.	Religeuse	Subcapital	A	Ether	Union	70 days	154 days	4 mos.
3	Sept., 1907	65	F.	Housewife	Subcapital	A	Ether	Union	77 days	9 mos.	6 mos.
4	July, 1908	71	M.	Restaurateur	Impacted intertrochanteric	A	None	Union	70 days	130 days	4 mos.
5	Mar., 1909	68	F.	Cook	Intertrochanteric	A	Chloroform	Union	65 days	70 days+	....
6	Jan., 1907	55	M.	Farmer	Impacted intertrochanteric	B	Ether	Union	63 days	154 days	3 mos.
7	Feb., 1908	16	M.	School-boy	Subcapital	B	Ether	Union	63 days	240 days	3 mos.
8	Jan., 1909	72	M.	Retired	Pertrochanteric	B	Chloroform	Union	89 days	243 days	1 year
9	Oct., 1909	74	F.	Housewife	Intertrochanteric	B	Chloroform	Union	65 days	80 days	3 mos.
10	Aug., 1910	46	M.	Motorman	Intertrochanteric	B	Ether	Union	78 days	117 days	4 mos.
11	Jan., 1911	59	F.	Housewife	Intertrochanteric	B	Ether	Union	72 days	....	....
12	July, 1911	49	F.	Housewife	Impacted intertrochanteric	B	Ether	Union	62 days	47 days+	....
13	Dec., 1911	60	F.	Housewife	Intertrochanteric	B	Ether	Union	80 days	1 year	1 year
14	Feb., 1912	50	F.	Housemaid	Impacted intertrochanteric	B	Gas	Union	70 days	115 days	4 mos.
15	May, 1912	60	F.	Seamstress	Intertrochanteric	B	Gas	Union	64 days	80 days	5 mos.
16	Jan., 1912	45	M.	Tailor	Impacted subcapital	B	Ether	Union	60 days	95 days	7 mos.
17	Feb., 1912	57	M.	Laborer	Pertrochanteric	B	Ether	Union	68 days	50 days+	....
18	Feb., 1912	46	M.	Laborer	Intertrochanteric	B	Ether	Union	72 days	....	....
19	July, 1913	60	F.	Housewife	Intertrochanteric	B	Ether	Union	49 days	....	....
20	July, 1913	43	M.	Butcher	Intertrochanteric	B	Ether	Union	56 days	104 days	2 mos.
21	Nov., 1914	42	M.	Laborer	Pertrochanteric	B	Ether	Union	42 days	54 days	3 mos.
22	Dec., 1914	?	M.	Laborer	Pertrochanteric	B	Ether	Union	Not given	....	....
23	Mar., 1915	65	F.	Housewife	Intertrochanteric	B	Gas	Union	42 days	111 days	4 mos.+
24	Sept., 1914	60	F.	Housewife	Intertrochanteric	B	Gas	Union	70 days	180 days	....
25	Jan., 1910	74	F.	Housewife	Intertrochanteric	B	Chloroform	.....	16 days	....	....
26	June, 1908	70	F.	Housewife	Subcapital	C	None	Died	59 days	....	....
27	Nov., 1913	72	F.	None	Intertrochanteric	C	None	Non-Union	72 days	2 years	....
28	May, 1914	76	F.	None	Intertrochanteric	D	Novocaine	Union	92 days	110 days	1 year
29	Dec., 1914	69	F.	None	Impacted intertrochanteric	D	Gas	Union	52 days	Not calculated	....
30	Feb., 1915	60	F.	Nurse	Impacted intertrochanteric	D	Gas	Died	29 days	....	....
31	Oct., 1909	56	F.	Housewife	Subcapital	E	Ether	Union	80 days	6 mos.	1 year
32	Mar., 1915	56	M.	Hotel Mgr.	Intertrochanteric	E	Gas	Died	14 days	....	....
33	Mar., 1915	60	M.	Market driver	Intertrochanteric	F	None	Union	50 days	52 days	7 wks.
34	June, 1915	70	M.	Driver	Intertrochanteric	F	None	Union	48 days	4 mos.+	....
35	Sept., 1915	69	F.	Housewife	Impacted intertrochanteric	F	None	Union	38 days	1 mo. +	....
36	Nov., 1915	71	M.	Farmer	Intertrochanteric	F	None	.....	....	....	....

OLD FRACTURES

Number	Age of Fracture	Age	Sex	Occupation	Position of Fracture	Fixation	Anæsthetic	Immediate Result	Days in Bed	Period of Complete Disability	Period of Partial Disability
37	1½ years	65	F.	Housekeeper	Subcapital	A	Ether	Firm hip	70 days	....	....
38	17 years	38	M.	Blacksmith	Subcapital	B	Ether	Abduction	42 days	56 days	4 mos.
39	3 years	52	M.	Carpenter	Intertrochanteric	B	Ether	Abduction, movable hip	91 days	3 mos.	4 mos.
40	2½ years	52	F.	Storekeeper	Subcapital	B	Ether	Abduction, fixed hip	45 days	4 mos.	4 mos.
41	16 months	27	M.	Laborer	Commun. Intertrochanteric	B	Ether	Non-Union	70 days	....	....
42	10 months	37	M.	Driver	Intertrochanteric	F	Ether	Union	48 days	2½ mos.	3 mos.
43	8 months	40	M.	Sailor	Subcapital	F	Gas and Ether	Union	49+30days	3 mos.	2 mos.

The period of complete disability means the period in which the patient depends on assistance for ordinary movements, and does not include the time in bed. Partial disability indicates the additional period in which the patient is able to move about without crutches, but cannot resume work or former activities. All the patients in this series are white.

traction cord is attached to the outer handle only and in this way the pull of the weight rotates the femur inward, in which direction it is assisted by a pad under the trochanter. The patient is put on a Gatch bed, with the leg piece made horizontal and the foot of the bed is kept elevated, so that the upper portion of the body makes counterextension, even when the patient sits up in bed.

Class E. Nailing the fragments. In one case of recent fracture we did an open operation, exposing the fracture, and fixing the fragments by means of a nail driven through the trochanter. In a second case a long drill was inserted through a small wound over the trochanter, and after the usual manipulations had been made, was driven through the reduced fragments into the head of the bone.

Class F. Loose fixation by tying out the knees to a spreader[1] attached to the bed rail.

The patient is put on a Gatch bed in a sit-

[1] The spreader is made from a smoothly dressed board, about 36x6x1 inches, having 4 holes, at either end. These holes, 1 inch in diameter, are arranged in pairs, about 6 inches apart, each set beginning 4 inches from the outer edge of the spreader.

RECENT FRACTURES

Extent of Permanent Disability due to Fracture	Percentage of Former Wages Earned after Recovery	Ultimate Result, December, 1915	Complication or Handicap at Time of Injury	Number
None	100	Died 1913	None	1
Slight stiffness of hip	Not affected	Living, well and active	None	2
1 cm. measured shortening	Not affected	Living, well and active	None	3
1 cm. measured shortening	75	Died 1911	Syphilis, arteriosclerosis	4
No note	75	Lost after discharge from hospital	Alcoholism	5
2 cm. measured shortening	100	Well and active	None	6
None	Not affected	Died 1912, pneumonia	None	7
None	Not affected	Well and active	Chronic nephritis	8
None	Not affected	Died 1912	Colles fracture	9
2 cm. short, limited motion	70	Wears rubber heel for shortening. Occasional pain	Fracture clavicle and ribs	10
No note	..	Lost after discharge from hospital	None	11
No note	..	Lost after discharge from hospital	None	12
1 cm. shortening, stiffness and œdema	Not affected	Well and active	Fat and flabby, pressure ulcer	13
None	100	Well and active	Pulmonary tuberculosis arrested	14
1½ cm. shortening	100	Well and active	None	15
3 cm. measured shortening	80	Active, leg well abducted, no limp	None	16
....	..	Lost after discharge from hospital	None	17
....	..	Lost after discharge from hospital	None	18
....	..	On crutches because of old fracture	Fracture of other hip, healed in adduction	19
None	100	Well and active	None	20
None	90	Well and active	None	21
....	..	Lost after discharge from hospital	None	22
Stiffness of the hip	Not affected	Walks with a cane; pain and stiffness	Arteriosclerosis	23
Pain, helplessness	..	Died June, 1915, heart disease	Mitral insufficiency	24
....	..	Died 3 days after fixation, uræmia	Alcoholism, nephritis, loss of control of bladder and rectum	25
....	..	Died 58 days, nephritis	Chronic alcoholism	26
Total helplessness	..	Unable to walk or otherwise help herself	Left hemiplegia, incontinence of urine	27
3 cm. short, œdema	..	Walks with a cane, has pain and œdema	Phlebitis and œdema, ulcer of heel	28
....	..	On crutches because of complication	Fracture tibia and fibula 3 months after discharge	29
....	..	Died 29 days, uræmia	Alcohol and drug addiction	30
Rigid hip	..	Walks without apparatus, no shortening, stiffness of hip	Obesity	31
....	..	Died 4 days after operation of pulmonary œdema	Fracture clavicle, B. P. 170, râles in chest	32
None	50	Slight foot drop, limitation of hip movements	Varicose veins, thrombophlebitis, ext. poplit. neuritis	33
....	..	No pain or swelling, still on crutches	Chronic interstitial nephritis	34
....	..	On crutches, no pain.	Fracture impacted in abduction	35
....	..	Patient still under treatment.	.....	36

OLD FRACTURES

Extent of Permanent Disability due to Fracture	Percentage of Former Wages Earned after Recovery	Ultimate Result, December, 1915	Operation	Number
5 cm. shortening, stiff hip	..	Walks on crutches and high shoes, nearly helpless	Head of bone excised	37
Rigid hip	100	Walks easily, is blacksmith to circus	Subtrochanteric osteotomy	38
2 cm. shortening	Not obtained	1911, 3 years after operation at work	Freshening and nailing fragments	39
3 cm. short. Limp	100	1912, 3 years, died of intestinal obstruction	Subtrochanteric osteotomy	40
....	..	1914, died, embolism after 2nd fixation	Freshening fragments and animal bone peg	41
2 cm. shortening	100	½ inch lift on heel. At same work	Freshening fragments, tie out	42
Not estimated on account of an old fracture of shaft	..	Slight shortening, good motion. In Insane Asylum	Freshening fragments, autogenous bone peg	43

ting position with a pillow behind the sacrum and the shoulders. The middle section of the bed is lifted so that the knees and hips are flexed to about 30° and the foot section is raised so that it is nearly horizontal. A soft rope attached to an overhead beam, allows the patient to move about by grasping it in both hands.

A covered felt pad is fastened by adhesive plaster under the trochanter of the fractured side. The sound leg is abducted fully and is made fast to one side of a spreader by a roll of gauze folded to make a soft bandage, which is first wrapped around the thigh above the condyles, just tight enough to avoid constriction. The thigh of the injured side is now rotated in and abducted as far as possible, and is then tied out to the other end of the spreader. The spreader is next attached to the bed rail by straps or bandages. The foot of the bed is elevated, and the pillows are removed from behind the sacrum and the shoulders. As the weight of the trunk pulls away from the tied out thighs, traction is made which gradually overcomes the shortening, and as the adductor muscles tire, the abduction may be increased until finally after a few days both limbs are fully abducted.

CASES NOT TREATED

Number	Date of Injury	Age	Sex	Occupation	Position of Fracture	Extent of Permanent Disability Due to Fracture	Ultimate Result December, 1915	Reason for Non-treatment
44	June, 1908	54	F.	Milliner	Subcapital	Died 4 days	Died 4 days, Delirium tremens	Delirium tremens
45	Sept., 1908	83	F.	None	....	Complete	Living, gets about in wheel chair	Obesity, dyspnoea, cyanosis
46	Sept., 1908	59	M.	Merchant	....	Died 2 days	Died 2 days, pulmonary œdema	Delirium tremens
47	Dec., 1909	73	F.	None	Intertrochanteric	Able to walk on crutches	Lost after discharged from hospital	Feebleness
48	July, 1910	74	F.	None	Subcapital	....	Lost after discharged from hospital 4th day	Kidney insufficiency. Restlessness
49	Aug., 1910	69	F.	None	Intertrochanteric	Died 25 days	Dead—Œdema of lungs	Restlessness, feeble heart, loss of control of bladder
50	Dec., 1911	68	F.	Housewife	Impacted intertrochanteric	Died 20 days	Dead—Pneumonia	Bronchitis, failing heart
51	Old fract.	35	F.	Housewife	Impacted subcapital	Walked with a crutch	Unchanged	Refused operation
52	Jan., 1914	88	M.	None	Intertrochanteric	Complete	Living, helpless	Chronic nephritis, apoplexy, senile dementia
53	Oct., 1914	80	F.	None	....	Died 3 days	Died 3 days, shock	Shock, fracture humerus and clavicle
54	Old fract.	35	F.	Coat Maker	Badly united Intertrochanteric	Pain and limp, stiff hip	Unchanged	Refused treatment
55	Sept., 1915,	78	F.	None	....	Died 10 days	Died, failing heart	Feebleness, emaciation

If the patient's general condition will permit, the reduction is done under general anæsthesia and the limbs tied out in complete abduction at once.

By moving the various sections of the Gatch bed the position of the patient may be changed without damage to the fracture, and in this way the danger of hypostatic congestion be avoided. The slight movement of the fragments permitted seems to stimulate new-bone formation.

Old fracture of the neck of the femur requires treatment on account of non-union or because deformity interferes with locomotion. For non-union the head may be excised and the neck fragment or trochanter placed in the acetabulum, or the ends of the fragments may be freshened and put in apposition for bony union. Direct fixation by means of a nail, an absorbable peg or an autogenous bone graft may be used to secure approximation and to stimulate bone formation.

When the fracture has united with deformity, subtrochanteric osteotomy is usually done. For the common deformity, adduction with outward rotation, a wedge-shaped piece of bone is removed from the outer and forward portion of the femur just below the trochanter and the bone is bent outward into abduction of about 20° and twisted as far inward as is possible without making a complete fracture. Overcorrection of the adduction is the important object of the operation.

Twelve patients in this series were not treated. Two young women declined operation for the relief of deformity following old fracture. One woman aged 74 was taken home by her relatives on the eighth day, after an unfavorable prognosis had been given. This patient as well as another woman who left the hospital unimproved ten weeks after the injury, cannot be traced. Two patients are known to be alive, one a man of 88 and the other a woman of 90, one year and seven years after the injury.

All the usual contra-indications to elective operation apply in determining whether or not a patient should be treated for a fracture of the neck of the femur. Certain particular conditions have been noted in studying the fatal cases.

1. Circulatory. The presence of dilatation of the heart, intermittent or irregular pulse, and extremes of blood-pressure are reasons for non-interference.

2. Pulmonary. Congestion of the lungs from any cause is a positive contra-indication to anæsthesia and firm fixation dressing.

3. Renal. Most patients with a fractured neck of the femur have some kidney insufficiency. The phthalein test will indicate the vigor of the kidneys and be a guide for the inauguration of treatment. Uræmia has a

prominent place in causes of death in this series.

4. Nervous. Lack of control of bladder and rectum is probably part of a general neurological breakdown. Restlessness, irritability, and delirium may be uræmic manifestations, or signs of alcohol and drug habits. If persistent these conditions indicate a fatal outcome, and the patient should not be treated. Unconsciousness has the same significance.

The fifty-five cases of fracture of the neck of the femur here reported have been observed during the past eight years. Seven patients cannot be traced. Of the remainder 17 are now dead and four are helpless, either on crutches or in wheelchairs as a result of the fracture. There are 46 recent and nine old fractures in the series. Thirty-six recent cases were treated and 10 were not. Of these 36 cases 4 patients died during the treatment, 13 were completely cured, 8 partially cured. In 3 cases sufficient time has not passed since the fracture to allow an estimate to be made. One patient is unimproved, 1 patient was seriously incapacitated by pain until her death six months after she left the hospital. Six patients cannot be traced all of whom left the hospital in good condition, apparently cured.

Of the 4 fatal cases, one patient developed uræmic symptoms, restlessness, and irritability, with occasional short periods of unconsciousness twelve days after the injury and died on the fifty-eighth day. A second patient died three days after fixation. In this case the examination of the urine before anæsthesia did not indicate a kidney insufficiency. The patient was vigorous in appearance, but she was unable to control the passage of urine and fæces, almost constantly soiling the bed. The occurrence of this condition seems to indicate a fatal outcome. It was also present in three of the fatal untreated cases. The third patient died on the twenty-ninth day, after a stormy illness. She was almost maniacal as a result of the use of alcohol and narcotics and finally died in uræmia following 2 days of convulsions. The fourth patient died of œdema of the lungs 4 days after fixation.

THE INDUCTION OF LABOR IN NORMAL PELVES AT TERM[1]

By CHARLES B. REED, M.D., F.A.C.S., Chicago

THE physiological duration of human pregnancy is as yet known only approximately, and the factors that determine the onset of labor are even more obscure. Nevertheless, we do know that while gestation may vary normally from 240 to 330 days, yet the child is fully mature in 275 days of accurately observed time.[2]

Von Winckel also shows that the continued growth of the child *in utero* after maturity brings with it an increasing danger of morbidity and fatality both to the child and to the hostess and by operative complications greatly intensifies the obstetrical problem.

Thus the time for the beginning of labor is by no means an indifferent matter, nor is it an affair that should be left altogether to accident or to the uncertainty of chance or physical idiosyncrasy. We surely should give to the human family the amount of attention and care the horticulturist bestows upon his apples. The apple is picked at maturity—why not the child?

Is it not possible in the conduct of labor to replace obscurity and uncertainty by clarity, conviction, and method both in its beginning and in its end; to replace the "watchful waiting" of the midwife by the wise control of the scientist; in a word put obstetrics where it belongs in the domain of clean surgery?

During the past year the writer has been seeking, at Wesley Memorial Hospital, to simplify and regulate the course of labor along the line of a high surgical conservatism. The primary question is, Can we assure ourselves that the child is mature and, given a mature child, shall we determine the onset of labor?

The writer believes we can and should do these things and herewith presents some preliminary observations for consideration and record.

The estimation of the child's maturity has been a most interesting study, for babes may be mature and show great differences in size and weight. For this reason it is necessary to strike an average and take advantage of the generous latitude which Nature allows in all her processes. We, therefore, assume that a mature child is 50 cm. long and weighs between five and eight pounds; for we fully accept Von Winckel's dictum that a child of more than eight pounds is a post-mature child in 70 per cent of the cases. Undoubtedly, to base any procedure upon such an assumption demands that judgment be assisted by a keen intuition and corrected by a constantly growing experience. Nevertheless, the results have been highly satisfactory. In other words, while the method does not possess an astronomical accuracy, yet, in practice, it works.

In addition to the routine measurements of the pelvis, we obtain our estimate of the child's size, first by its length according to Ahlfeld's rule and then its comparative head size by Mueller's method of crowding the head into the pelvis. In our series of cases the length of the child rarely varied more than 2 cm. from the actual post-partum findings and usually was as close as 1 cm. or less. The variation also was safely below rather than above the actual figures.

Thus Ahlfeld's rule, which hitherto has possessed merely a remote academic interest, becomes practically important. The rule is simple. In vertex cases measurements are made with the pelvimeter from the upper border of the symphysis to the breech of the child, the result is doubled and 2 cm. subtracted for the thickness of the abdominal walls. The result is the length of the child. Additional information may be obtained in special cases through a comparison of the head of the child with the maternal pelvis by the Mueller maneuver under anæsthesia. Consideration of the cephalic index of the parents also has a certain value.

Our figures are again corrected by the

[2] Von Winckel. Duration of pregnancy. Deutsch. Klin., 1914.

[1] Read before the Chicago Gynecological Society, November 19, 1915. (For discussion see page 370.)

history of the case, the last menstruation and the day of quickening. If the patient is intelligent, both of these facts are of great value when considered in relation to the anatomical findings. We accept seventeen weeks from conception as the approximate date of quickening and usually count twenty-two weeks from this day as the culmination of the pregnancy. The calculation is not absolute, of course, and sometimes a week more is allowed depending on the parity of the mother and her degree of intelligence. If the history and the anatomical findings are harmonious the day for the labor is definitely appointed.

The next step is to have the labor come on at the time set. The work may be done in any aseptic environment, but the hospital is preferable. The patient receives attention to the bowels the night before and in the morning is given careful obstetric preparation of external genitalia. Then under strictest asepsis a Voorhees bag is introduced *without* rupture of membranes. Brodhead's report of 139 cases in 1912, is pioneer work in this field and has not received the attention it deserves.

Our technique is as follows:

Assemble and sterilize by boiling 20 minutes, a Voorhees bag No. 4, a Simon speculum or vaginal retractor, a pair of long Pean forceps, 2 pairs vulsellum forceps, 1 dressing forceps, 2 pairs compression forceps, a Goodell dilator, 1 tenaculum forceps, a hand bulb syringe with glass tubes and rubber connections for the bag.

The patient, prepared as for delivery, is placed upon the table in exaggerated lithotomy position. Stirrups will serve.

The vagina is retracted, a smear made from the cervix, and the mucous membrane wiped clean with pledgets of gauze on forceps.

Anæsthesia is only occasionally necessary even in primiparæ.

Before using, the apparatus must be tested by forcibly filling the bag with sterile solution.

One lip of the cervix is seized by the vulsellum forceps and brought down. Usually even in primiparæ, the os is sufficiently patulous to admit the bag; if not, dilate.

The bag is emptied of residual air and fluid and the flat end pulled out. It is now rolled up into a compact mass like a cigarette and seized with Pean forceps, so that the tips extend just to the largest diameter of the rolled bag. Anoint with sterile glycerine, turn the curve of the forceps toward the patient's left leg, and introduce. As the bag enters, turn the mass to the operator's left—a quarter turn—so that when the operation is completed the forceps curve looks upward. Release lock on forceps. Connect tube with syringe and force sterile solution slowly into the bag. Pean forceps may be removed as bag fills. Remove vulsellum. Tie tube with tape when bag is full, disconnect syringe. Put sterile pad on either side of tube.

If pains do not start within an hour, or if compression is desired as in placenta prævia, or a more rapid dilatation, then a weight of one or two pounds is attached by a tape to the protruding tube and passed over the foot of the bed. Usually in from five minutes to half an hour contractions begin and labor has been inaugurated just as one would start the pendulum of a clock.

In a variable period, rarely more than four hours—three hours and twenty minutes was the average in our series—the bag is expelled by strong pains, the dilatation is practically complete, the head follows the bag down, the membranes rupture, and the second stage begins. From now on the case is managed according to general obstetrical principles. If the pains are weak and shallow, pituitrin may be indicated; if strong and regular, morphine and scopolamine or gas or chloroform may be added. The tedious, exhausting, and painful first stage has been materially shortened and definitely controlled. The bag acts as a dynamic stimulant to the contractions, as well as a mechanical aid to cervical dilatation, and it preserves the membranes from injurious pressure until physiological rupture occurs.

Theoretically there are two objections to this procedure which were ever before us: The possibility of infection was the one most dreaded. Hence for months we made smears from the vagina and cervix of all

cases. Naturally we found every variety of pathogenic organism, including the streptococcus, staphylococcus, and gonococcus. The bag was introduced nevertheless and none of these women had temperature postpartum. It is our belief that the shortening of the labor process and the preservation of maternal vitality maintains the maternal immunity and prevents the infection that would easily and probably follow a more prolonged labor whether induced or uninduced. If this should prove to be true, we may ultimately look back on the policy of "watchful waiting" as an evasion of responsibility that is unjustifiable.

The second danger is the possibility of prematurity. This happened once in our series. The case was not supervised and an interne, who had made enough measurements for educational purposes and was supposed to be reliable, measured the uterus instead of the fœtus and the result was a seven months' child. This danger is practically nil when proper care is used.

It has been urged as an incidental objection to the bag that it frequently changes the position of the presenting part. We have found this to occur demonstrably only two or three times and not unfavorably. In fact in several instances the attempt has been made to secure such a change, but the Voorhees bag with its flat top does not lend itself readily to this object.

The results obtained by the use of the bag in a series of one hundred consecutive cases are herewith submitted.

Primipara, 35; multipara, 65; average duration of labor, seven hours forty-five minutes; shortest labor fifty-five minutes; longest labor, thirty hours in a primipara with a cartilaginous cervix and twenty-eight hours in a multipara with much cicatricial tissue in the cervix.

The bag broke, during or shortly after insertion, six times, and was reinstated three times. The average time for the expulsion of the bag was three hours twenty minutes. The membranes were ruptured by the introduction of the bag twice.

There were two maternal deaths: one from placenta prævia complicated with myocarditis and one from pneumonia eight days after labor. Neither death can be charged to the bag.

The average weight of the babies was 7.7 pounds, the smallest child weighing 5 pounds and the heaviest 10 pounds five ounces.

Seven babies died; one, the child of a primipara after a spontaneous labor of sixteen and a half hours, was born in asphyxia pallida, was revived with difficulty, and died eight hours later. The second, the child of a multipara, was born blue after a spontaneous labor of one hour and thirty minutes, was revived, and died suddenly thirty-six hours later. The third and fourth children died from compression of the cord by the head at the outlet, one of these being also syphilitic. The fifth and sixth were delivered with forceps from primiparæ with contracted pelves; one in the occipitoposterior position was stillborn, the other lived two hours. The seventh child was delivered prematurely. This is the only case attributable to the method and we believe it was wholly unnecessary.

There were three cases of version and extraction, for placenta prævia, transverse presentation, and prolapsed cord. There were four cases of breech presentations, two of placenta prævia, one of prolapsed arm, one of mitral stenosis, one of mitral insufficiency. There were 17 cases of lacerations of the perineum, of 2 degrees or less, and episiotomy. One case presented grave albuminuria.

Forceps were used in 23 cases as follows: Axis traction in 2; low forceps for occipitoposterior position of head, 9; deep transverse arrest, 8; insufficiency of the powers, 4. Four of these might be called *schulezange*.

Seven cases had post-partum temperature: Case 1 had pulmonary tuberculosis with evening rise of temperature. Case 2 had pneumonia. Case 3 had a temperature due to mastitis, which went to 102°, lasted twenty hours on the third day, and disappeared under the ice pack. Case 4 had a temperature on the ninth day which went as high as 105° and was probably due to an old pelvic infection or to the nurse who had a suppurating injury of foot which she did not report until too late. This temperature ran two weeks and developed a mass in the pelvis which ultimately absorbed. Case 5 had a temperature due to the prolonged labor —30 hours—which went to 102° on the second day and lasted for three days. There were no pelvic symptoms. Case 6 had a temperature due to colitis. It was 104° on the fourth day and lasted 24 hours. There were no pelvic symptoms except the diarrhœa. Case 7 suffered a temperature due to nervousness and after-pains. On the second day the temperature was 102° and remained so for twelve hours. There was no pelvic tenderness and the temperature subsided under bromides.

In no case except Case 4 was there tenderness over or beside the uterus; neither foul discharge or subinvolution. None of these cases, therefore, unless it be Case 5, can be attributed to the bag.

In only one case was post-partum catheterization necessary as compared with former methods of delivery.

The writer ventures to call attention

particularly to the number of forceps cases, which is far higher than the number reported from most clinics. It is quite probable that some of the occipitoposterior positions would have rotated and that a certain number of the arrested heads would have delivered if time enough had been allowed.

But it was a deliberate part of this investigation to shorten the labor wherever it could be done without increasing the danger of injury to the mother or child. It was thought, and we now believe wisely, that by preserving the maternal vitality and immunity the advantage would more than counterbalance the slight increase of danger involved in the interference. It is more than probable that in skilful hands the courageous use of forceps is safer for mother and child than a timid reliance on the aimless powers of Nature with the possibility ever present of an ultimate employment of forceps. At the same time it is not felt that the resort to instruments has been in any degree hasty, for before external aid is decided upon our routine requires that we ascertain the position of the head; that we learn the character of the pains and know that dilatation is complete. Then, if necessary, pituitrin is used to strengthen the pains and a time limit is allowed for molding and delivery of the head, which approximates one and one half and two and one half hours in multiparæ and primiparæ respectively.

The absence of infection in the cases where pathogenic organisms were present is extremely interesting and significant since it may ultimately prove that bacteria are a relatively negligible factor in short labors. Furthermore, as the work has gone on, we have all been more and more impressed by the freedom from post-partum exhaustion and nervous prostration in these cases and their quick convalescence. This can hardly be unexpected since a process that shortens labor anywhere from four to twelve hours must necessarily result in a tremendous saving of energy and vitality. Our observations thus far lead us to believe that the bag can be used freely and harmlessly both in primiparæ and multiparæ and in normal as well as pathological cases. It removes and overcomes the principal obstacle in a majority of labors—the undilated cervix—and leaves us only the bony pelvis as an obstruction and this too in a patient whose strength is as yet unreduced.

The only exceptions we are inclined to consider at present are the multiparæ with much cicatricial tissue in the cervix and primiparæ where the same part is thick and hard. These are difficult cases however under any circumstances and it is probable that our experience in future will show that such women have far more satisfactory labors *with* the bag than without it. Moreover these cases are close to pathology and should be considered separately—in the class with contracted pelves.

The highest advantage of our procedure lies in the fact that the course of labor is entirely under the control of the obstetrician from start to finish. There is no timidity, indolence, or dubiety. The day is appointed; the cervix is dilated slowly or quickly, the contractions are strengthened or weakened; the pelvis is enlarged or let alone; complications are boldly met or foreseen and avoided; the labor is hastened or prolonged; the pain is permitted, diminished, or abolished according to the judgment of the operator. The process works in strict harmony with the principles of modern science.

THE PHYSIOLOGICAL METHOD OF TENDON TRANSPLANTATION [1]

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II. Operative Technique

THE physiological method of tendon transplantation has as its basic principle the correlation of every step of the operation as well as the indications therefor and the after-treatment with the normal mechanics of tendon motion. It takes cognizance not only of the course and insertion of the tendon as given in the anatomical textbooks, but of many other less known but equally important facts, such as the blood supply of the tendon, its fascial relations at various levels, its length, range of motion, its action, not merely in the normal situation, but when the point of insertion has been altered, the exact location and inner architecture of its sheath, the character and line of insertion of the mesotenon, and the bursæ associated with the tendon. All these details cannot, of course, be given in this paper. For them I must refer the reader to the monograph "*Die physiologische Sehnenverpflanzung*" by Biesalski and Mayer.[2]

A physiological tendon operation must conform not only with the general surgical principles of absolute asepsis, minimal hæmorrhage and minimal traumatism, but also with the following demands:

1. It must wherever possible restore the normal relationship between the tendon and the sheath.

2. The course of the tendon from its original site to that of the paralyzed tendon must run through tissue adapted to the gliding of the tendon. Injury to the periosteum or the crude boring of a hole through fascia or interosseous membrane is inconsistent with this demand.

3. The normal insertion of the tendon must be imitated wherever possible by implanting the living transplanted tendon directly into bone or cartilage, preferably at the insertion of the paralyzed tendon.

4. The normal tension of the transplanted tendon must be reëstablished and the physiological length of the transplanted muscle thus maintained.

5. The line of traction of the transplanted tendon must be such as to enable it effectively to do the work of the paralyzed tendon.

Description of Three Typical Physiological Tendon Transplantations

1. Transplantation of the Extensor Proprius Hallucis for the Tibialis Anticus

The operation is indicated only in cases of comparatively slight paralytic valgus, for the extensor proprius hallucis, even on the assumption of its functional hypertrophy subsequent to the operation, is not strong enough to replace the tibialis anticus.

1. *The first skin incision*, 4 cm. long, bowed with the convexity toward the sole of the foot is made over the insertion of the tibialis anticus.

2. *Preparation of the implantation site for the extensor hallucis.* The tendon of the tibialis anticus at its insertion is slit longitudinally for 3 to 4 cm., and the bone or cartilage of the internal cuneiform is grooved for the reception of the extensor tendon (see Fig. 6 *A*).

3. *The incision over the extensor proprius hallucis tendon.* This runs in the line of the tendon from a point 3 cm. above the tip of the internal malleolus to the middle of the first metatarsal bone. The reason for this long incision is evident, when the sheath of the tendon has been opened. Then it is seen that the mesotenon attaching the tendon to the floor of the sheath is too well developed to allow withdrawing the tendon from the sheath through a small supramalleolar incision.

It is well, however, not to expose the tendon unnecessarily at this stage of the operation, but to leave it *in situ*, until all has been made

[2] Published by Springer, Berlin.

[1] The first article in this series of papers on "Tendon Transplantation" appeared in the February 1916 issue, p. 182.

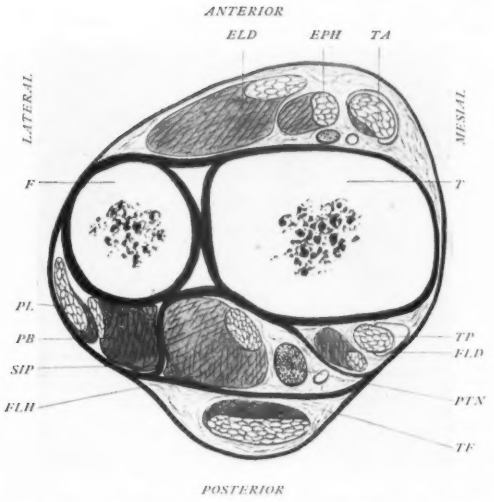

Fig. 1. Cross section, drawn from microscopic section, (semidiagrammatic) of the calf 5 cm. above the tip of the internal malleolus. The section lies below the proximal pole of the tibialis anticus, above the sheaths of the extensor proprius hallucis and extensor longus digitorum. Note that the three anterior muscles lie in the same fascial compartment. *ELD*, Extensor longus digitorum; *EPH*, extensor propius hallucis; *TA*, tibialis anticus and sheath; *T*, tibia; *TP*, tibialis posticus and sheath; *FLD*, flexor longus digitorum; *PTN*, posterior tibial nerve; *TF*, deep transverse fascia; *F*, fibula; *PL*, peroneus longus; *PB*, peroneus brevis; *SIP*, septum intermusculare posterius; *FLH*, flexor longus hallucis.

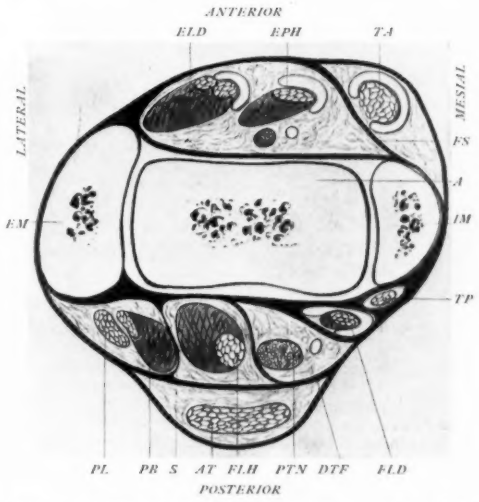

Fig. 2. Cross section, drawn from microscopic section, (semidiagrammatic) of the calf 3 cm. distal to the section shown in Fig. 1. Here the sheath of the three anterior tendons are present. Note that the tibialis anticus is separated from the other extensors by a fascial septum. *ELD*, Extensor longus digitorum; *EPH*, extensor propius hallucis; *TA*, tibialis anticus; *FS*, fascial septum; *A*, astragalus; *IM*, internal malleolus; *TP*, tibialis posticus; *EM*, external malleolus; *PL*, peroneus longus; *PB*, peroneus brevis; *AT*, Achilles tendon; *S*, septum intermusculare posterius; *FLH*, flexor longus hallucis; *PTN*, posterior tibial nerve; *DTF*, deep transverse fascia; *FLD*, flexor longus digitorum.

ready for transferring it into the sheath of the tibialis anticus.

4. This transfer requires an accurate knowledge of the fascial relations between the two tendons. Figure 1, a diagrammatic cross section through the calf about 5 cm. above the tip of the malleolus shows the three anterior muscles of the calf lying within the same fascial compartment. Figure 2, about three centimeters distal to the first, shows the extensor proprius hallucis and the tibialis anticus divided from one another by a fascial septum derived from the fascia cruris. To run the extensor hallucis through this fascial septum would not be physiological. On the other hand, freeing the extensor hallucis to the level of the first cross section, where both muscles lie within the same fascial compartment, would involve sacrificing many muscle-fibers and important blood-vessels, since the origin of the extensor hallucis extends downward almost to the level of the malleoli. Fortunately, nature has indicated a suitable path. At one point, usually about 2 cm. above the malleolus, the septum separating the tendons is so thin as to be transparent. This is the site of election (see Fig. 3). Here the operator can draw the extensor tendon into the sheath of the tibialis anticus, confident in the knowledge that serious post-operative adhesions will not result. Since this point lies slightly above the upper pole of the extensor hallucis sheath, the fascia over the extensor must be incised for 2 to 3 cm. proximal to the sheath. The mesial fascial edge is grasped with the clamp shown in Fig. 4 and raised until the operator sees this thin portion of the septum. Here a small incision is made directly into the tibialis sheath. An eye-probe is passed through this incision in the line of the tibialis tendon, made to puncture the lower end of the sheath,

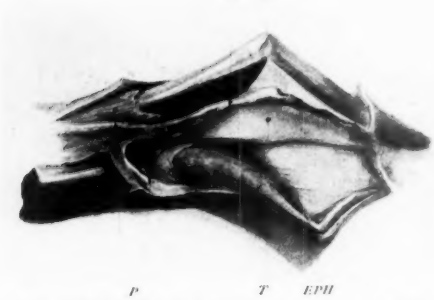

Fig. 3. Dissection showing the fascial septum separating the tibialis anticus from the extensor proprius hallucis. The tendon sheaths have been opened, the tibialis anticus has been lifted out of the sheath, the extensor proprius hallucis drawn to one side. The preparation demonstrates the thin portion of the septum where the transfer of the tendon is least liable to cause dangerous adhesions. *FS*, Fascial septum; *TA*, tibialis anticus; *P*, plica; *T*, thin portion of the fascial septum; *EPH*, extensor propius hallucis drawn to one side.

and to appear over the insertion of the tendon.

5. The sheath of the extensor hallucis tendon is then slit open its entire length. The tendon is divided near the middle of the metatarsal bone, its end grasped with the tendon clamp and the mesotenon divided close to the tendon until the operator reaches the lowermost muscle-fibers. The vessels of the mesotenon are thus sacrificed, but a large vessel which runs through the lowermost muscle-fibers can always be spared. The tendon end is threaded with chromic catgut by the stitch shown in Fig. 5, the free ends of the suture are passed into the eye of the probe and the tendon thus readily drawn through the sheath of the tibialis anticus.

Withdrawing the tibialis anticus tendon from the sheath as first advocated by Biesalski produces needless trauma and is unnecessary, since the sheath does not closely invest the tendon, but is large enough to accommodate two tendons.

6. Fixation of the tendon. Here the knowledge of the laws of tendon tension is important, since otherwise the operator is likely to sew the tendon under too great tension and thus throw an unnecessary burden on the transplanted muscle. It may be remembered that in outlining the physiology of tendons I showed that when the muscle is relaxed under narcosis and its origin

Fig. 4. The author's tendon clamp.

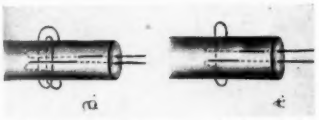

Fig. 5. The fixation suture: *A*, single stitch; *B*, double stitch. The sutures combine great mechanical stability with comparatively little trauma to the tendon.

and insertion are approximated, the tendon itself, as well as the muscle-fibers, have a zero tension. Therefore, to give the transplanted tendon the exact physiological tension, one must merely approximate the origin of the muscle and its new point of insertion (in this instance, by holding the foot supinated and flexed dorsally), draw the tendon downward until it runs in a straight line, and suture it under just sufficient tension to maintain this desired course. With a little experience the operator knows beforehand just how long the tendon must be to reach its new point of insertion and the chromic gut suture, inserted to draw the tendon through the sheath, can thus be used as the fixation suture.

The implantation site has already been prepared (see second step of the operation) by slitting the tibialis tendon lengthwise and traumatizing the periosteum of the internal cuneiform. The tendon, threaded by the fixation suture shown in Fig. 5, is now fastened securely between the two halves of the tibialis tendon. The sutures are threaded on a stout cervix needle or an instrument resembling a shoemaker's awl, and are passed through bone or cartilage, ligament, and fascia. The fixation must be mechanically fast. When properly executed it can withstand a traction of 20 to 30 pounds.

This mechanical fixation does not, however, meet the physiological demand, for firm though the suture is at the time of the operation, experimental work has shown that such

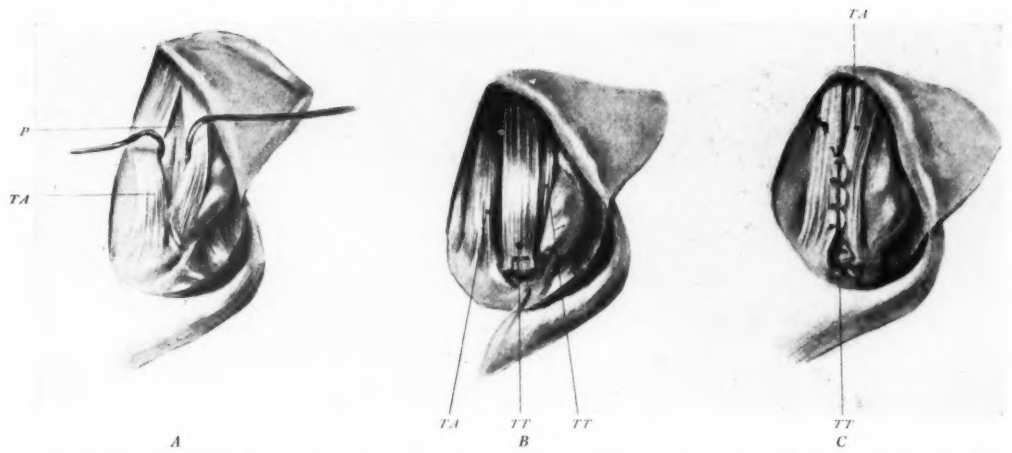

Fig. 6. The fixation of the transplanted tendon. The extensor proprius hallucis is being transplanted to replace the paralyzed tibialis anticus. *A*, (at left) Preparation of the fixation site. The tendon of the tibialis anticus is slit lengthwise and the periosteum of the internal cuneiform traumatised, so as to stimulate bone growth. *B*, The tendon of the extensor proprius hallucis, threaded with the fixation suture shown in Fig. 5, is fastened securely by several deep stitches passing through bone, ligament, and fascia. *C*, The tendon of the tibialis anticus is sutured to the extensor tendon, thus rendering the mechanical fixation still firmer and assuring a physiological fixation by pressing the extensor tendon against the traumatised periosteum. *P*, Periosteum of the internal cuneiform; *TA*, tendon of the tibialis anticus, slit longitudinally; *TT*, transplanted tendon.

a suture produces a necrosis of the tendon, and therefore there is a possibility that subsequently the tendon may slip from its moorings. This slipping, however, is prevented by suturing the paralyzed tibialis tendon over the extensor hallucis (Fig. 6). In this way the living tendon-cells of the extensor proprius hallucis above the fixation suture are brought into direct contact with the periosteum and with the tendon of the tibialis anticus (Fig. 7). Thus the fixation is rendered physiological as well as mechanical, for in the healing process, even though the tendon distal to the fixation suture necroses, an intimate union above this point is bound to occur between the tendon and the traumatized periosteum.

7. The distal stump of the extensor tendon is fastened to the adjacent tendon of the extensor longus digitorium, the fascia is closed, and thus the normal ligaments of the foot are restored. The skin incisions are closed without drainage.

11. CONVERSION OF THE TIBIALIS ANTICUS INTO AN ABDUCTOR AND PRONATOR

This operation is indicated in cases of paralytic or spastic talipes varus, and in some cases of congenital club-foot. It should be performed only when a marked degree of correction is required, for the action of the muscle is so powerful as easily to produce an overcorrection. When slighter grades of varus are present, the extensor proprius hallucis should be used instead of the tibialis anticus. The two operations are so nearly

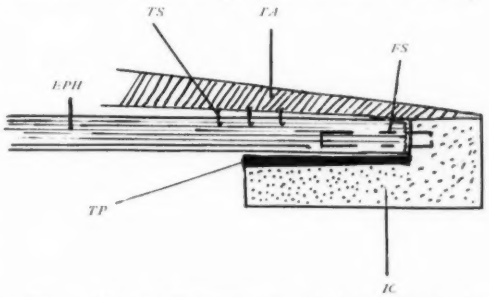

Fig. 7. Diagram illustrating the principle of the physiological tendon fixation. The fixation suture gives the mechanical stability; the adhesion of the tendon to the traumatised periosteum and to the superimposed tibialis tendon gives the physiological security. *TS*, Tendon sutures; *TA*, paralyzed tibialis anticus; *FS*, fixation suture; *IC*, internal cuneiform; *TP*, traumatized periosteum; *EPH*, tendon of the extensor propius hallucis.

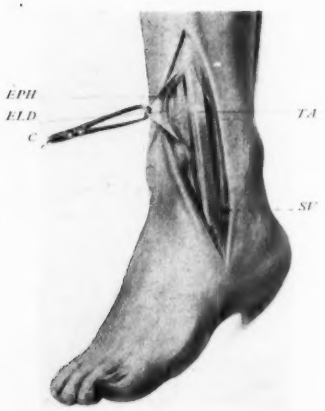

Fig. 8. Conversion of the tibialis anticus into an abductor and pronator. The tendon has been laid bare from the proximal pole of its sheath to its insertion, and the fascia cruris drawn lateralward with the clamp exposing the tendons of the two long extensor muscles. These tendons in contradistinction to the tibialis anticus are still enveloped in connective tissue—the paratenon, since the upper pole of their sheaths lies distal to that of the tibialis. *EPH*, Extensor propius hallucis; *ELD*, extensor longus digitorum; *C*, clamp retracting the incised fascia cruris; *TA*, tibialis anticus; *SV*, internal saphenous vein.

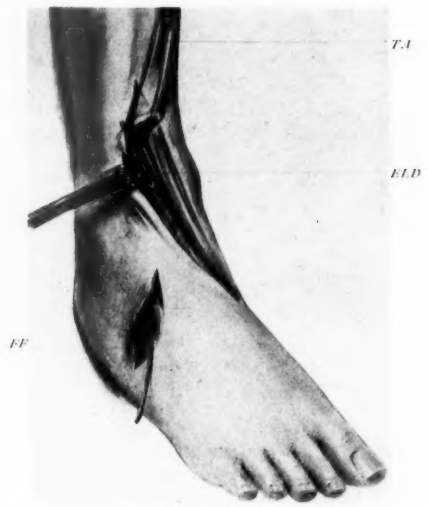

Fig. 9. Conversion of the tibialis anticus into an abductor and pronator. The implantation site has been prepared by an incision exposing the insertion of the peroneus tertius, the tendon has been slit longitudinally, and the periosteum of the metatarsal bones traumatized as in Fig. 6. The tibialis anticus, threaded with the fixation suture has been lifted out of the sheath after carefully dividing its mesotenon. The free ends of the suture are attached to a probe which runs through the common sheath of the extensor longus digitorum and peroneus tertius, and emerges at its lower pole near the insertion of the peroneus tertius. *FF*, Flap of skin and fascia; *TA*, tendon of the tibialis anticus; *ELD*, tendons of the extensor longus digitorum.

alike that the description of the one suffices.

1. A four-centimeter curved incision is made over the insertion of the peroneus tertius (see Fig. 9). Skin, fascia and subcutaneous tissue are retracted to form a flap.

2. The tendon of the peroneus tertius, which in the dissection of 25 cadavers and in all the operations was invariably present, is then slit for several centimeters as in Fig. 6A and the metatarsal bones grooved for the reception of the tibialis anticus.

3. An incision is made in the course of the tibialis tendon from the upper pole of its sheath, 3 to 5 cm. above the malleolus, to its insertion (Fig. 8). The sheath is opened near its upper pole. Here again the exact knowledge of the sheath, its limits and inner architecture is necessary for the neat execution of the operation.

4. It will be remembered that in describing the first operation attention was called to the fascial relations of the three anterior muscles of the foot: the tendons above the upper pole of the tibialis sheath lie in the same fascial compartment, then for several centimeters the extensor proprius hallucis and the extensor longus digitorum lie in the same fascial compartment separated from the tibialis anticus by a fascial septum. From the level of the malleolus downward there are three such compartments, one for each of the three anterior muscles (Fig. 10).[1] The transfer of the tibialis tendon is best made above the fascial septum separating it from the extensors, since in this way danger of adhesions is entirely avoided.

The lateral margin of the divided fascia just proximal to the upper pole of the tibialis sheath is retracted until the extensor longus digitorum is visible (Fig. 8). This level lies above the upper pole of the extensor sheath. To enter the sheath the loose connective tissue surrounding the extensor tendons —

[1] The tendons of the extensor longus digitorum and of the peroneus tertius lie in the same compartment.

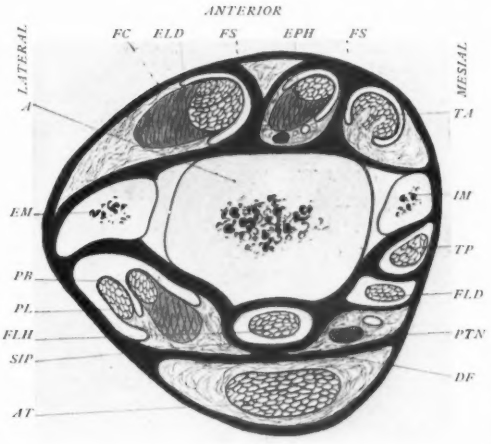

Fig. 10. Cross section (semidiagrammatic) of the calf 1 cm. proximal to the tip of the malleolus. The sheaths of the three anterior muscles are shown. Note that each tendon lies in its own fascial compartment (see also Figs. 1 and 2). *FC*, Fascia cruris; *ELD*, extensor longus digitorum and peroneus tertius; *FS*, fascial septum; *EPH*, extensor proprius hallucis; *TA*, tibialis anticus; *IM*, tip of internal malleolus; *TP*, tibialis posticus; *FLD*, flexor longus digitorum; *PTN*, posterior tibial nerve; *DF*, deep fascia; *A*, astragalus; *EM*, tip of external malleolus; *PB*, peroneus brevis; *PL*, peroneus longus; *FLH*, flexor longus hallucis; *SIP*, septum intermusculare posterius; *AT*, Achilles tendon.

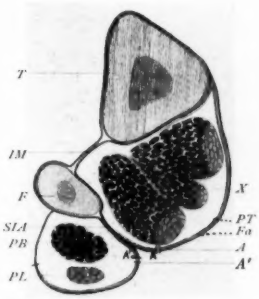

Fig. 11. Diagrammatic cross section of the calf illustrating the fascial plastic for transferring the peroneus longus from its fascial compartment into the anterior fascial compartment. The fascial edge *A* is united by a Lembert suture with the edge *A'*. Its deep surface coated with gliding tissue — the paratenon — is thus everted to serve as a physiological path for the peroneal tendon. *T*, Tibia; *IM*, interosseous membrane; *F*, fibula; *SIA*, septum intermusculare anterius; *PB*, peroneus brevis; *PL*, peroneus longus; *X*, anterior muscular compartment; *PT*, paratenon; *Fa*, fascia; *AA'*, fascial incisions.

the paratenon — is incised until the bare tendon cells are reached. A probe passed along the tendon is then certain to enter the sheath. Passing the probe through the sheath again calls for a knowledge of its inner architecture. All five tendons, the four extensors and the peroneus tertius are connected with one another by means of a common mesotenon. The operator must be careful to pass the probe superficial to the tendons; otherwise he will draw the tibialis anticus between the extensor tendons and thus tend to interfere with their function as well as its own. The probe is guided in the direction of the peroneus tertius, made to puncture the lower pole of the sheath, and to appear between the fascia and the tendon near its insertion.

5. The sheath of the tibialis anticus is now slit open its entire length and the fascia below the sheath incised until the insertion of the tendon is visible (Fig. 8). The tendon must be divided as near the bone as possible; otherwise it would not be long enough to reach its new point of insertion. It is then threaded with stout chromic gut as in Fig. 6 and freed from its mesotenon until it can run a direct course into the sheath of the extensor digitorum and peroneus tertius.

6. The tendon is drawn through the sheath by means of an eye-probe (Fig. 9) and fastened to the bone and to the peroneus tertius tendon by the technique described in the first operation. Care must be taken that the course of the tendon is straight and that the muscle is not twisted.

III. TRANSPLANTATION OF THE PERONEUS LONGUS FOR THE TIBIALIS ANTICUS

The operation is indicated in cases of spastic or paralytic talipes valgus. This operation possibly better than any other illustrates the advantages of the physiological method of tendon transplantation. The operation as usually performed does not efficiently replace the paralyzed tibialis anticus, for unless the peroneal tendon runs through the sheath of the tibialis tendon a supinating effect is impossible. This fact can readily be demonstrated by experiments on the cadaver as well as by clinical experience. The operator, however, faces a grave difficulty in running

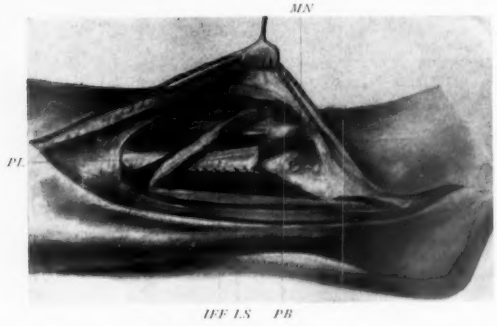

Fig. 12. The transplantation of the peroneus longus for the paralyzed tibialis anticus. The fascial plastic has been executed and the tendon can pursue a physiological course from its fascial compartment to the sheath of the tibialis anticus. The Lembert suture, when properly introduced, does not come in contact with the peroneal tendon, since the suture is covered by the muscular fibers of the peroneus brevis. *PL*, Tendon of the peroneus longus; *MN*, musculocutaneous nerve; *IFF*, inverted fascial flap; *LS*, Lembert suture; *PB*, peroneus brevis.

the peroneal tendon from its original site to the sheath of the tibialis anticus, for the two muscles are separated throughout their entire length by a well-developed fascial wall — the septum intermusculare anterius. To overcome this difficulty, a fascial plastic operation is necessary.

The steps of the operation are as follows:

1. Incision over the insertion of the tibialis anticus as in the first operation, and preparation of the plantation site by slitting the tibialis tendon and grooving the internal cuneiform.

2. A three centimeter incision near the upper pole of the tibialis sheath enables one to open the sheath and to pass a probe threaded with a guide-suture through it to the insertion of the tendon. The probe is drawn entirely through, leaving the guide-suture in place.

3. The third skin incision is made over the peroneus longus tendon from the middle of the calf to the cuboid. This long incision is necessary, for unless the tendon is freed almost to the middle of the calf it cannot be given a proper line of traction. The upper end of the incision curves anteriorly so as to permit the execution of the fascial plastic. The skin and subcutaneous tissues above the malleolus are retracted from the underlying fascia cruris until not only the peroneal muscles, but also the muscles of the anterior group — the extensors — are visible.

4. The fascial plastic. Experimentally we know that the boring of a hole through the fascial septum tends to produce adhesions, whereas it is equally evident that the deep surface of the fascia from the middle of the calf downward is unusually well adapted to the gliding of the tendon, because it is clothed with the elastic paratenon. Therefore instead of ripping a hole through the fascia with the dressing forceps it is carefully incised first over the peroneal compartment, then over the anterior muscular compartment (see Fig. 11). This latter incision is made to outline a flap (Fig. 12) which is inverted so as to expose the paratenon clothing its deep surface, and sutured by a Lembert stitch to the edge of the inverted fascia of the lateral fascial compartment (see Fig. 11). The stitch itself is taken as near as possible to the fibula, so as to bury it in the muscular fibers of the peroneus brevis. By this simple procedure a physiological path for the peroneal tendon is constructed. The fascial incision must be somewhat longer than at first thought seems necessary, because the tendon runs not transversely but slanting from above downward.

5. An eye-probe is then passed from the upper pole of the tibialis sheath beneath the fascia cruris and made to appear in the region of the fascial plastic. The upper end of the guide suture lying in the tibialis sheath (second step of the operation) is drawn beneath the fascia by means of the probe. The guide suture thus runs from the fascial plastic beneath the fascia cruris into the tibialis anticus sheath, downward through the sheath and out near the insertion of the tibialis tendon. It serves to draw the peroneal tendon along this course.

6. The peroneal tendon is now freed by prolonging the fascial incision already made over its upper end, downward until the sheath has been opened, usually 3 to 4 cm. above the malleolus, and then along the sheath to the groove in the cuboid where the peroneal tendon passes into the sole of the foot. When the peroneal tendon is divided at this point,

it reaches exactly the desired insertion on the inner border of the foot. It is threaded with the fixation suture, freed from its mesotenon, and by means of the guide suture drawn over the fascial bridge downward through the tibialis sheath. Fixation to the internal cuneiform, as in the first operation.

The fascial incisions are closed wherever possible, not only to restore the normal anatomical relations, but also as far as possible to prevent post-operative hæmorrhage.

Summary of the Physiological Tendon Transplantations

In these three operations it has been possible to meet all the demands of the physiological method. The physiological principle is, however, applicable even when no tendon sheath is present. Thus, for instance, in the case of the paralyzed quadriceps femoris, a physiological tendon plastic can be performed by running the substituting tendons through the subcutaneous tissues. In some instances the sheath can for a short distance be transplanted with the tendon, e.g., the extensor proprius hallucis can, under some circumstances, be more advantageously transplanted with its sheath than by running it through the sheath of the tibialis anticus.

As a result of my study the following operations can be termed physiological.

These operations are not meant to form a closed system. It is earnestly to be hoped that further experimental and clinical work will enable us to include other operations in this category.

1. FOOT

1. *For talipes valgus.* (a) Extensor proprius hallucis through the sheath of the tibialis anticus, or transplanted with the sheath to the inner border of the foot. (b) Peroneus longus through the sheath of the tibialis anticus. The fascial plastic is in this instance necessary. *a* and *b* can be advantageously combined; the peroneal tendon is run through the tibial sheath, the extensor hallucis tendon is transplanted with its sheath. (c) The extensor longus digitorum and the peroneus tertius subcutaneously to the inner border of the foot. In the operation the normal relation between tendon and sheath cannot be restored, but all other demands of the physiological method are met. (d) The flexor longus digitorum through the sheath of the tibialis posticus, inserted into the scaphoid. The flexor digitorum is in its original situation a supinator and an abductor, but transferring its insertion to the scaphoid increases this action and helps to maintain the normal contour of the foot.

2. *For talipes varus.* (a) Tibialis anticus through the sheath of the extensor longus digitorum and peroneus tertius to the base of the fifth metatarsal bone. (b) The extensor proprius hallucis through the same sheath to the same insertion. This operation is indicated in milder cases of varus deformity. (c) The flexor longus hallucis through the sheath of the peroneus brevis to the fifth metatarsal. This operation is extremely difficult technically, since the tendon must be freed in the sole of the foot and its attachment to the flexor longus digitorum, present in 95 per cent of the cases, must be severed before the tendon can be transplanted. At one point in its course from its original sheath to the peroneal, the tendon must pass through a fascial septum, the septum intermusculare posterius. To this extent the operation fails to meet the physiological demand but the fatty upper pole of the flexor hallucis sheath can for a short distance be transplanted with the tendon and thus protect it from gross adhesions to the fascia.

3. *For talipes calcaneus.* (a) Flexor longus hallucis to the tuberosity of the os calcis. (b) Peroneus longus to tuberosity of the os calcis. *a* and *b* are advantageously performed at the same time. When the talipes calcaneus is combined with marked cavus deformity a preliminary astragalectomy (Whitman) is indicated.

4. *For talipes equinus.* (a) Transplantation of the peroneus longus through the tibialis anticus sheath to the internal cuneiform. (b) Transplantation of the peroneus brevis subcutaneously to the base of the fourth metatarsal. *a* and *b* are always performed together.

Other operations for talipes equinus, such as transplanting the tibialis posticus, the

flexor longus digitorum and the flexor longus hallucis prove, after careful cadaver experiments and clinical observation, to be unphysiological.

5. *Claw toe.* Jones's operation of inserting the long extensor tendon into the head of the metatarsal bone meets all the physiological demands.

II. KNEE

1. *For paralysis of the quadriceps extensor.* (a) Subcutaneous transplantation of the biceps to the patella. (b) Subcutaneous transplantation of the sartorius, gracilus or semitendinosus to the tuberosity of the tibia. It is well to combine the transplantation of the biceps with one of the muscles of the second group, so as to prevent an outward dislocation of the patella. The semimembranosus does not lend itself to transplantation, because it is needed to maintain the stability of the posterior capsule of the knee.

III. HAND

1. *For paralysis of the extensors.* (a) Flexor carpi radialis through the sheath of the extensor carpi radialis longior to the base of the second metacarpal bone. (b) Flexor carpi ulnaris subcutaneously to the tendon of the extensor carpi radialis. The tendon is too short to reach the bony insertion, but it can be sutured to the extensor tendon sufficiently near the insertion of the latter to give good operative results. This operation should never be performed alone, since the extensor carpi ulnaris has little extensor effect, except when combined with the extensor carpi radialis.

c. Flexor sublimis digitorum subcutaneously to the extensor communis digitorum or through the sheath of the extensor carpi radialis longior and brevior to the base of the second and third metacarpal bones. The latter operation is indicated, when extension of the fingers is possible, but extension of the wrist not.

2. *For replacing the extensor tendon of a single finger.* Transplantation of the index finger tendon of the extensor communis digitorum.

3. *For replacing the flexor tendons of a single finger.* Transplantation of the adjacent flexor sublimis digitorum tendon.

IV. ELBOW

For paralysis of the biceps. Transplanation of the long head of the triceps subcutaneously to the insertion of the biceps.

CONCLUSION

In this, the second paper dealing with the physiological method of tendon transplantation, I have indicated the practical application of a knowledge of tendon anatomy and physiology to the technique of tendon operations. Each step of the operation must accord with the normal mechanics of tendon motion. The operations are essentially simple, although their description sounds complicated. Their neat execution, however, is by no means easy and requires not only good surgical technique but ample practice on the cadaver. Unless the surgeon can conscientiously meet these requirements he should not attempt the tendon transplantation.

In the third paper I shall report the experimental and clinical results of the physiological method of tendon transplantation.

OSTEOCHONDRAL TROPHOPATHY OF THE HIP-JOINT

By ARTHUR T. LEGG, M.D., Boston

At the meeting of the American Orthopedic Association in June, 1909, I reported five cases of what I then differentiated as "an obscure affection of the hip-joint." This paper, preliminary and tentative in character, was intended rather to focus the attention of other surgeons in orthopedic work upon the conditions which I believed had never been described up to that time, than to adequately present a theory of etiology or complete survey of clinical observations and end-results of treatment upon the cases in hand. I endeavored to present suggestions upon cause, course, and occurrence, and hoped to precipitate the report of similar cases from the practice of others.

After presenting these cases, I made a study of the literature which might have any bearing upon this affection and found reported as examples of other diseases of the hip, sporadic cases, which appeared to me as illustrations of a similar condition. These isolated instances were invariably described in conjunction with cases very dissimilar in character as related to already established types of disease and were not sorted into a special group which, through a definite symptomology, might be accepted as an entity.

Thus, as a juvenile form of arthritis deformans, a disease very different in all essentials from the one I describe, Dr. Hoffa of Berlin, in his text of 1903, reviewed several cases reported by Maydl and Mueller, to which a traumatic origin was assigned. In the same year, von Brunn, under the head of juvenile osteo-arthritis deformans considered at length four cases reported by Maydl and Zesas and added to them two cases of his own. Upon the etiological occurrence of a trauma, he stated in his conclusions that "trauma does not play, as heretofore thought, the single striking rôle, but a form of the sickness is idiopathic." In 1905, Dr. A. H. Freiberg reported as coxa vara adolescentium a case which appears to me identical with my own, but he relates this case and another presented simultaneously to the cases already mentioned.

These early cases have been mainly interesting to me from the discussion of traumatic etiology which they precipitated. They occurred between the ages of fifteen and twenty-seven mainly and, with the exception of Dr. Freiberg, osteophytes are described by each writer in at least one of his cases. The group is likewise important as the nucleus of the work of German and French writers who have in the past five years isolated into a diagnostic entity cases of identical symptomology with those upon which my attention has been concentrated.

The five cases which appeared in 1909, had crystallized into a group which, to my mind, was sharply differentiated from other bony deforming processes in the hip-joint in children. They presented a clinical picture distinctive and worthy of separate consideration. In these cases, the general physical condition of the children reporting with a limp was opposed very drastically to a conception of deep-seated disease.

The occurrence of a traumatism, definitely related in time to the appearance of the limp, made essential the etiological consideration of this factor. The course of the affection through a considerable period of time, with slow compensatory and reparative processes, studied in radiographs, showed a relationship to the calcium metabolism of bone, which seemed to me explicable only as associated with disturbances in circulation. Beyond the characteristic limitation in abduction and internal rotation, the general facts in these cases as then published were:

1. Age, five to eight.
2. History of injury.
3. Limp.
4. Thickening about the neck of the femur.
5. Absence of pain.
6. Absence of constitutional symptoms.
7. Little or no spasm.

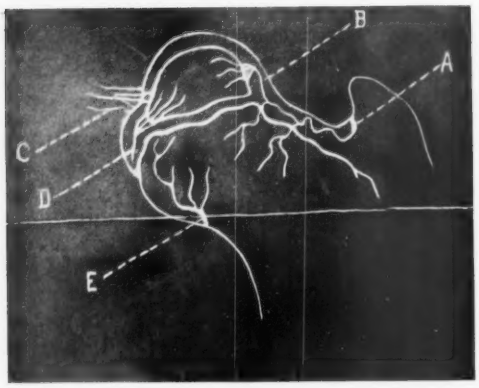

Fig. 1. Adopted from Waldenstroem. *A*, Upper diaphyseal vessel giving a branch *B* to the epiphysis; *C*, vessel entering through the ligamentum teres; *D*, branch to the lower side of the epiphysis; *E*, diaphyseal vessel to the lower side of the femoral neck.

8. Absence of shortening.
9. Typical X-ray appearance.

An experimental study upon atrophy in relation to disuse, the year before, had brought out interesting points with reference to circulation as an etiological factor.[1]

I offered in 1909, therefore, the hypothesis of trauma as the first cause producing a disturbance in the circulatory relationship between the epiphysis and the neck of the femur, the immediate result being atrophy in the former through a diminished blood supply, and hypertrophy in the latter. The hypertrophy seemed to me to be related to the hyperæmic condition induced, not only temporarily by traumatic congestion, but maintained for a considerable length of time by a proportionately increased blood supply where the blocking of the epiphyseal channels distributed a heavier circulation to the neighboring diaphyseal vessels. Adding to this disturbance the factors of pressure and growth, also through a definite period of time, my conclusion as to ultimate result was that pressure upon the epiphysis, atrophied by diminished blood supply, produced flattening; that growth, as especially stimulated in the hyperæmic upper diaphysis, produced thickening in the neck and modification in shape approximating the varus condition.

[1] See American Journal of Orthopedic Surgery, August, 1908.

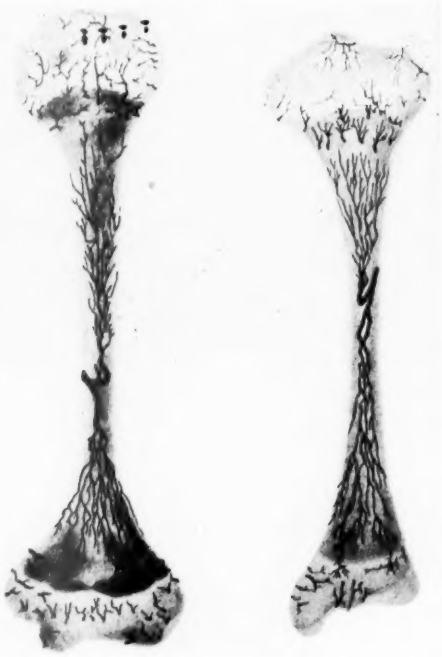

Fig. 2. Adopted from Lexer. Injected femora of infants showing vascular distribution.

A year after this, in July, 1910, from some five hundred cases of "coxalgie," Jaques Calvé selected ten instances of a form of "pseudo-coxalgie." In his opinion, this small group of cases, apparently identical with my own, presented differential points sufficiently characteristic to warrant a special classification and discussion. In my comparative chart of symptomology at the end of this article, I give a tabulation of the principal characteristics observed by him.

Beyond the coincidence of symptoms in these cases of Calvé's, I would emphasize as bearing upon my idea of the disease the occurrence between the ages of three and one-half years and ten; the fact that the children, with one exception belonged to the working classes, a point which Emslie accentuates as in favor of the traumatic production of certain forms of coxa vara; and the otherwise excellent general health of the children.

In the study of his cases, it is interesting to

Fig. 3. N. T., 1153. Traumatic case involving both sides. Resulted in perfect recovery of motion with cap deformity of the epiphysis.

Fig. 4. G. Z., 859. Traumatic case involving left hip. Resulted in perfect recovery of motion with mushroom deformity of epiphysis.

note that the three in which the onset of the affection is acute, accompanied by severe pain, fever, swelling of the joint and spasm, are the ones (II, IV, V) in which the tuberculin reaction was positive. Calvé does not consider the tuberculin test, in view of the other facts, an indication in these cases of a tuberculous lesion in the hip. The course of the disease and the end-result was the same as in the other cases. The condition cleared up in six months' to a year's treatment, mainly by plaster immobilization, and the radiographs were typical. Calvé's discussion of this matter is very interesting and complete.

His idea upon etiology is that earlier rachitic conditions by deforming the osseous structures in the hips and producing disturbances of metabolism were probably or possibly the first cause of the disease. He emphasizes the fact that the deformity of the hip distinctly precedes the arthritis where this is evident; that neither ankylosis in the joint nor atrophy in the femur shaft occur; that the process is brief. In spite of one case of definitely traumatic origin (III), he did not consider trauma as a causative factor. Mechanical origin from strain conditions, similar to that of flat-foot or genu valgum, is mentioned but pronounced insufficient.

Two of the closing sentences of his discussion are suggestive. "Perhaps, it should be thought that the mechanical irritation, which follows in the train of this deformity, has created a region of lessened resistance, a point of appeal for those light customary infections which occasion chronic or subacute arthritis, never specific, such as I have described before in my article on the difficulty of diagnosis of coxalgie in its onset. . . . It appears to me materially impossible to make a conclusion on the actual state of affairs. We have only wished in this study, to point out a clinical type of arthritis of the hip, which, it appears to us, does not correspond to any type so far described and which until recently in our own opinion, has been taken for tuberculous coxitis."

Almost simultaneously with Calvé's discussion, Sourdat, in his study of "coxalgie" called attention, in the review of two hundred and fifty radiographs, to nine special cases. Of the skiagraphs in question he claimed that the conditions were so similar, that they were practically superposable: "The articular space is enlarged, the epiphysis shows itself to be flattened: the neck of the femur is a varus more or less pronounced and generally little accentuated; it is thick-

Fig. 5. E. E., 2551. Negative case involving both sides. Resulted in perfect recovery of motion with cap deformity of the epiphyses.

Fig. 7. M. D. Case not reported in paper. End-result recently obtained. Case of operative trauma. Pre-operative X-ray.

ened." He agreed with the statements of Calvé that the arthritis in these cases is of short duration and that ossification in the epiphysis is diminished, also that there are occasional rachitic appearances in the femur. He left the solution of the cause of the deformity, however, to further clinical study.

From the report of Hennig Waldenstroem on "Tuberculosis of the Neck of the Femur in Children," Stockholm, 1910, I have selected seven cases as belonging in a separate group, and to these, two of the cases of Sinding-Larsen and one of Forssell, as quoted by Waldenstroem, have been added. These cases were first chosen as belonging in the group with my own, from the study of the published schematic radiographs and the actual radiograms, and were then verified by a consideration of the clinical histories. In the original article the case numbers are as follows: Waldenstroem 15 to 21 inclusive; Sinding-Larsen 1 and 2; Forssell 2.

Fig. 6. W. C., 4925. Negative case involving the right hip. Resulted in practically perfect recovery of motion with mushroom deformity of the epiphysis.

The study of the histories brought out the following interesting points: the predominant occurrence among boys, eight out of ten; trauma as the initial factor in the production of the limp in eight cases; in the two remaining cases the limp had preceded Waldenstroem's treatment by three and six years respectively, and the general condition of the children had been excellent in the intervening years; typical limitation in abduction; trochanteric elevation; constant röntgenographic appearance with flattening of the epiphysis and thickening of the femoral neck.

The general condition of the neck of the femur in these cases is one of hypertrophy with the attendant increase in density of the

Fig. 8*a*. M. D. Case not reported in paper. End-result recently obtained. Case of operative trauma. Post-operative X-ray.

Fig. 8*b*. M. D. Case not reported in paper. End-result recently obtained. Case of operative trauma. End-result one year after operation.

röntgen shadow, but at points there are areas of increased radiability. Such areas are described by Waldenstroem as tuberculous foci and their location is related by him to the distribution of the upper diaphyseal circulation. Very rarely, identical regions of diminished shadow density occur in my own radiograms in cases definitely non-tuberculous. Even with the positive tuberculin or von Pirquet reaction, a diagnosis of tuberculosis from such evidence in the radiogram, in the absence of further symptoms, is at least insecure. My own experience with reference to these reactions is that they are not adequate without other data for the localization of tuberculous lesions in the hip. In this Calvé and Perthes concur. In my cases, out of fifteen in which the reaction was tried, three gave a positive von Pirquet; in these tuberculous adenitis was demonstrated.

Case 18 from Waldenstroem is worthy of especial study as a splendid developmental series of radiographs in which the stages of the flattening of the epiphysis are excellently illustrated.

Waldenstroem mentioned in his paper the condition of juvenile arthritis deformans, but concluded that the etiology was widely different in the cases reported and that the subject at the time lacked the adequate unity for definite ideas, for the reasons of "insufficient observation" in cases reported, "inadequate radiograms," "röntgen examination lacking" at times, and "incomplete preparation in the pathological resections made."

Though I differ with Waldenstroem in the classification of his own cases, I have shared with him in no small degree the difficulty which he apparently encountered, as indicated in the above quotations, in his effort to study the cases presented under the name of juvenile arthritis deformans. The radiograms in many cases are so lacking in clear-

Fig. 9. J. K., ZZ-324. Traumatic case involving the right hip. X-ray taken immediately after traumatism. Subsequent changes in the epiphysis and neck identical with other cases. Resulted in slight limp and motion limitation in abduction and a cap deformity of the epiphysis.

Fig. 10. J. M., LL–192. Traumatic case involving left hip. Resulted in perfect recovery and mushroom deformity of the epiphysis. End-result X-ray taken fourteen years after onset. Illustrates permanence of the epiphyseal and femoral modifications which develop during the active period of the disease.

ness, at least in the published form, that a very definite idea of some of the modifications is impossible. The idea of the occurrence of osteophytes permeates the early reports, and in some of the cases, those of von Brunn for instance, I do not feel sure about the condition he describes as "*Allenthalben hängen am Rande umfangreiche Randwülste über, am starken nach unter zu.*" What these overhanging marginal proliferations are, whether osteophytic or not, I am uncertain, since reproductions of the X-rays are not given in the *Beitrage zur klinischen Chirurgie* in which the article by von Brunn appeared.

The general discussion of pathological anatomy, which follows his case reports, makes the condition described even more problematic. Von Brunn states that pathological examination was not possible in his cases but quotes and apparently accepts the statement of earlier authors that "marginal proliferations (*Randwülste*) or osteophytes, in the form of stalactites, separate the joint cartilage from the neck." A case which really develops osteophytes does not belong to the disease of the hip at present considered. It is possible that true osteophytes are not here described, though the word osteophyte is used, but rather irregularities in osseous deposition, since German writers, to whom the original plates are probably accessible, accept some of these cases as the disease so ably described by Perthes.

In spite of the difficulty encountered in grouping these early cases, owing to variations in the use of terms and the report of symptoms, attention and study concentrated on such cases, through the accumulation of data gradually a type was established, and a new clinical entity has emerged into the category of juvenile diseases affecting the hip.

This is very largely due to the work of Dr. Georg Perthes, who after making a preliminary study in 1910, both clinical in his own cases and bibliographical in the prior reports, in 1913, presented a classical monograph on the affection in question, and suggested at the same time a new name. This paper upon "Osteochondritis deformans juvenilis," not only added the data of fifteen new cases of his own to those he described in the earlier study, but it is the strongest discussion of the subject yet presented, and sharply differentiates osteochondritis deformans juvenilis from arthritis deformans on the one hand, from which the former name was derived, and from tuberculous conditions on the other.

It was to hold the idea of the disease apart from that of arthritis deformans that he suggested the name to which Brandes and later writers have conformed. This differentiation is based upon the facts that arthritis deformans affects the joint cartilage, a condition clinically associated with the characteristic crepitation, and that it progressively intensifies unless modified by early treatment or operation, to the point of ankylosis of the joint. The flattening of the epiphysis and the thickening of the femoral neck, upon which the original similarity to the juvenile hip deformity was based, occurs as an intermediate condition and is associated with those other pathological disturbances in ossification which produce pendulous outgrowths or osteophytes upon the femoral neck. Perthes, therefore, substituted for the term osteo-

arthritis, osteochondritis, because the joint cartilage is not affected but the lesions are subchondral, occurring in the bone beneath the joint cartilage. Such a differentiation was most important in eliminating an erroneous idea, but points descriptively related to the nature of the disease itself seem to me more significant in determining its name.

The clinical and röntgenological picture presented by Perthes is very perfect, and to him the medical profession is indebted for one of its classical studies. The outline of his symptom-complex is given later in conjunction with that of other writers in the comparative chart of symptomatology.

From Kiel, in September, 1914, Dr. Max Brandes published a paper in which ten cases were reported and discussed. This article offers strong supplemental support to the Perthes' separation of cases of subchondral deformation of the hip in children which do not result in great limitation of movement, under the new name of osteochondritis deformans juvenilis, into a special group, and emphasizes that this should be done without reference to tuberculin reactions, subcutaneous or von Pirquet. Recovery in the hip within a reasonably short period of time with a fair range of motion raises a doubt in his mind of the tuberculous character of a case reported. His statement concerning the tuberculous neck foci of Waldenstroem is considerably more sweeping than my own, and the complete series, in his opinion, should probably be grouped as osteochondritis deformans juvenilis. He further suggests that the notably successful cases of the treatment of tuberculous arthritis of the hip in children are not the results of improved treatment in this disease, but mistaken diagnoses of tuberculosis of the hip for osteochondritis deformans juvenilis, in which the end-results of the latter disease have been attributed to the former.

Very recently, in the April number of *The American Journal of Orthopedic Surgery*, Dr. Francesco Delitala has contributed an article upon this subject to which the name of Perthes' disease is applied. His study covers the especially interesting phases of the work of Perthes, Schwartz, and Negroni, particularly from the point of view of the pathological anatomy as far as it is at present known, and makes the further review of the matter he has so ably discussed unnecessary here. After the presentation of my own cases, however, I shall be obliged to differ from him on points in the etiology and the early bone changes more completely than is necessary with any other contributor to the investigation of this disease.

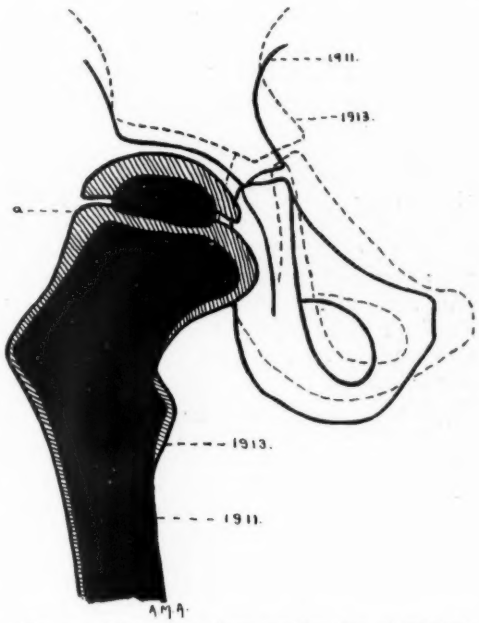

Fig. 11. Diagram to show modifications of epiphysis and neck. Made in exact outline by lens superposition and reduction from original X-rays, in case of H. M. 1911, was taken immediately after the onset before bone modification had occurred. 1913 is the end-result of the series of radiograms. The pelvic changes are those to be normally expected of growth and have not been emphasized in the diagram but only given in outline.

For the past nine years I have been studying this special hip affection, and I have followed the subsequent history of my earlier cases and added to the number of my observations until my present statistics cover fifty-five personally observed cases. This study has not lead me to change my earlier opinion upon etiology, and I am prepared to strengthen and elaborate from considerably augmented data the conclusion arrived at in 1909.

To a consistent view of the etiology and course of this disease, a preliminary survey of the facts of circulation in the hip region involved is necessary. Circulation in the epiphysis and neck was worked out by Lexer, and somewhat later more completely by Waldenstroem by means of vascular injections of crude turpentine and mercury. The radiographic study of these injected femora established the occurrence of (a) a vessel to the upper neck entering just above the great trochanter and giving a branch to the epiphysis of the head; (b) a vessel on the under side of the neck; (c) a small vessel to the under portion of the epiphysis, similar in distribution to the epiphyseal branch of (a) above; (d) a vessel of small size and limited ramification passing into the epiphysis through the ligamentum teres (see Fig. 1). The distribution of the epiphyseal vessel is circular, coming up from the diaphyseal region and turning into the epiphysis in such fashion as to surround the epiphyseal line like a calyx (see Fig. 2). Some of the vessels interlace so far as is determined across the epiphyseal line. A close comparative study of the arrangement of the circulation with reference to the epiphyseal line shows definitely that a trauma which effects an actual or approximate epiphyseal dislocation would create a very great disturbance in circulation and would necessitate at this region of bone increase a regeneration of the capillary and immediately supracapillary vessels of the utmost importance to the calcium metabolism and growth.

Hyrtle has claimed that the vessel into the ligamentum teres turns back upon itself without taking part in the vascular nourishment of the epiphysis. Lexer's researches were upon infants, and other anatomists at that time claimed that the vessel extending into the ligament did not function after the age of two years. Waldenstroem, however, demonstrates this vessel in children of five, but shows a very limited ramification for it, with a comparatively small relation apparently to nutrition. In view of the research upon the origin and function of the ligamentum teres by Morris, in which his conclusion is that this ligament is a modified tendon of the pectineus muscle (ambiens) which in lower animals serves as a check on certain muscle combinations in rapid movements, it is quite possible that the conflicting opinions on the vascular supply of the ligament indicate varying degrees in the development of the circulatory channels here. Evolutionary study very generally shows much individual variation in an organ of transferred or disappearing function.

The circulation in this entire region is I believe a factor of extreme importance. In connection with the demonstration of the relation of circulatory stoppage to ossification in the neighborhood of the epiphyseal line, I have under way a series of experiments upon animals, which I trust will give definite results as to the modifications of calcium metabolism after interference with the circulatory channels.

As systematic clinical data bearing intrinsic evidence in occurrence, association, and development, to a circulatory disturbance in osseous deposition and absorption in the epiphysis and upper dyaphysis, of which a traumatism is the first cause, I now bring forward the fifty-five cases already mentioned.

My earliest interest in these cases was awakened by the fact that the children came in at the Out-Patient Department of The Children's Hospital on account of a limp only. Associated with this single abnormality was no special complaint of pain, no prior conditions of disease, no definite symptoms of the customary pathologic coxitic affections. In general the appearance of the limp, in spite of its frequent relation to a traumatic experience of some sort, had produced no disturbance in the normal avocations of the child's life, and had created no special concern in the minds of the parents. In time, however, the persistence of the claudication began to have weight. The parents individually were led to consult a physician out of a vague concern for the child's welfare, rather than from any personal complaint on the part of the child. These children were in all cases strong, well developed, active in their habits, and thoroughly accustomed to the exuberant exercises of their period of life.

The clinical examination of the limb affected showed, besides such slight oscillations from the mean as occur in individual cases of any disease, the following symptoms, with which I have combined certain facts of occurrence and history:

1. Age, two and a half to twelve years.
2. Appearance of a limp, with relation to a distinct traumatism in thirty-seven cases.[1]
3. Trochanteric prominence on the side affected in standing position; apparent visually and upon palpation.
4. Limitation in motion: marked in abduction; slight in internal rotation. Flexion free.
5. No crepitation.
6. Capsular thickening about the neck of the femur.
7. Slight muscular atrophy on the side affected.
8. Little or no pain either subjective or upon manipulation.[2]
9. In general, little or no spasm.[3]
10. Trochanter slightly above Nelaton's line.
11. Positive Trendelenburg generally present.
12. Leg length equal with occasional variation either in shortening or lengthening.[4]
13. Von Pirquet negative. Tried in fifteen cases with positive results in three in which tuberculous adenitis was present.
14. Wassermann and luetin tests negative. Tried in five cases without reaction.
15. Family history negative.
16. Patient's history negative, with the exceptions given in thirteen. The ordinary diseases of childhood had occurred in various individuals. There were no disease symptoms of any sort for a period of six months prior to the onset of the hip affection.
17. No evidence of old rachitic condition.
18. Duration from six months to a year, varying with the intensity of the attack.[5]
19. Typical röntgen appearance consisting of an atrophied flattened epiphysis, either cap-like or mushroomed in shape (see Figs. 3 and 4 for types); hypertrophic thickening of the neck of the femur; an appearance of coxa vara. These modifications are persistent, but after the subsidence of the first attack, not progressive.

The clinical data concentrated from the original histories, the record number of which is given in each case, is presented in the following tables. I have divided the fifty-five cases into three groups.

I. Cases in which the patient definitely associated the appearance of the limp with a traumatic experience, listed as "Cases of Known Trauma."

II. Cases in which the parents did not report a trauma, but the child began to limp at a definite time without relation to prior disease, listed as "Negative Cases."

III. Cases following reduction of congenital dislocation, listed as "Cases of Operative Trauma."

A study of the first group, in addition to the constancy of symptoms in general, brings out several interesting points:

1. The greater occurrence in males than in females, in the proportion of nine to one.
2. The distribution of the affection between the ages of five and eleven, to which there is but one exception.
3. The fact that 50 per cent of the cases, came in for treatment from six months to four years after the limp was noted.
4. The sporadic occurrence of symmetrical cases involving both hips, two out of twenty-two.

The "Negative Cases" are less susceptible to generalization than the "Traumatic" group. A marked preponderance of males to females still exists, in a lower proportion, however (2.2 to 1). There is an association with pain in two cases, both girls, and both showing a greater motion limitation than usual. There are two symmetrical cases. The varia-

[1] This number includes the cases in which the bone modifications followed operation in cases of congenital dislocation of the hip. See Group III following.

[2] A moderate amount of persistent pain occurs occasionally. A special note to this effect is given in the tables wherever pain was reported.

[3] The sporadic occurrence of persistent spasm is indicated in the tables which follow.

[4] Shortening occurs rarely (2 cases), and is marked (from 1 to 1½ inches). Lengthening is also rare (2 cases), and is much more moderate in degree (from ¼ to ½ inch). There is apparently no difference in such cases in the X-ray findings or the clinical course. These figures do not refer to cases of congenital dislocation of the hip.

[5] This refers to the active duration of the disease, which I consider the period during which osseous modification is occurring in the joint. This is the period during which treatment is valuable. The permanence of the joint deformity results very often in a permanence of the limp and motion limitation long after the disease has run its course.

TRAUMATIC CASES

Record	Age	Sex	Etiology	Hip Affected	Motion Limitation	Articular Thickening	Type of Epiphysis	Recovery
J. G. 6513	3	M	Fall 1 week	Right	All limited	Slight	Cap	Perfect
J. W.[3] LXIV-128	3½	M	Fall 2 years	Left	Abduction Internal rotation	Slight	Cap	Limp improving
W. M. AAA-355	4	M	Fall 4 months	Right	Abduction Internal rotation	Slight	Mushroom	Slight limp and limitation
G. Z. 859	5	M	Fall 9 months	Left	Abduction Internal rotation	Slight	Mushroom	Perfect
E. W. 5737	5	M	Fall 4 years	Right	Abduction Internal rotation	Slight	*	Perfect
R. A. XX-364	5	F	Fall	Right	Abduction Internal rotation	Slight	Cap	Perfect
J. K. 4663	5¼	M	Kick 1 week	Left	All motions Slight limitation	Slight	Cap	Slight limp and limitation
N. T. 1153	6	M	Fall 1½ years	*Both*	Abduction	Slight	Cap	Perfect
J. E. G.[2] Private	6	M	Fall 9 months	Left	All motions Spasm and pain	Slight	Cap	End-result not reported
J. M. LL-192	6	M	Fall 2 weeks	Left	All motions slight Slight spasm	Slight	Mushroom	Perfect
J. M. CCC-41	6	M	Fall 3 months	Left	Abduction Internal rotation	Slight	Cap	End-result not reported
J. D. 5268	6½	M	Fall 6 months	Right	Abduction Internal rotation	Slight	Cap	Slight limp and limitation
J. K. ZZ-324	6½	M	Fall 5 weeks	Right	Abduction Internal rotation	Slight	Cap	Slight limp and limitation
L. D. 5196	6½	M	Struck 2 months	Left	Considerable general limitation Spasm and pain	Slight	Cap	Perfect
F. S.[1] 3347	7	M	Fall 1 month	Left	Abduction, internal rotation Slight spasm	Slight	Mushroom	No limp; slight limitation
C. M. 4332	7	M	Fall 2 months	Right	Abduction Internal rotation	Slight	Mushroom	No limp; slight limitation
M. M. 73	8	F	Fall 9 months	*Both*	Abduction, internal rotation, slight general	Slight	Mushroom	Perfect
R. H. 317	8	M	Fall 9 months	Right	Abduction. Internal rotation Slight spasm	Slight	Cap	Slight limp and limitation
F. M. TT-537	10	M	Thrown by cow 2 months	Right	Abduction Internal rotation. Slight spasm	Slight	*	Perfect
W. R. Private	10	M	Fall 9 months	Left	Abduction Internal rotation	Slight	Mushroom	Perfect
A. T. 6408	11	M	Fall 10 months	Right	Abduction Internal rotation	Slight	Mushroom	Present Case

[1] Shortening of the leg affected, one-half inch, in F. S. 3347.
[2] Necrotic area developed during observation of case: excision, staphalococcus present.
[3] An osteotomy performed for coxa vara with good results.
* X-rays broken in moving. Classification into types of head made subsequently to loss.
Perfect recovery cases are without limp or limitation in motion. The recovery in all cases is complete though a slight persistent limp and motion limitation persists after recovery in about 50 per cent of the cases.

tions which occur in no way preclude a possible unreported trauma, nor does the course of the affection and the end-result depart from that of the positive traumatic cases. The X-ray findings are identical in the two groups, and any history of a pathological hip process, prior or subsequent to the period of limp and treatment, is lacking. The clinical data taken under consideration by the physician is constant throughout: the patient's history, always susceptible to personal fluctuations both of memory and accuracy, is the variant. The latter factor, is I believe frequently to blame for the omission to note or report the relation of a trauma to the onset of the symptoms.

NEGATIVE CASES

Record	Age	Sex	Onset	Hip Affected	Motion Limitation	Articular Thickening	Type of Epiphysis	Recovery
A. N. 5622	3¼	M	Limp 6 weeks	Left	Abduction Internal rotation	Slight	Mushroom	Perfect
H. M. 4158	4	M	Limp 3 months	Right	Abduction	Slight	Cap	Perfect
G. D.[2] T-30	4	M	Limp 6 months	Right	Considerable general limitation Considerable spasm	Slight	Mushroom	Slight limp and limitation
E. L.[1] ZZ-289	5	F	Limp 6 months	Left	General limitation Spasm, slight pain	Slight	Mushroom	Lengthening, left
A. D.[1] 4336	5¼	F	Limp 5 months	Right	Abduction Internal rotation	Slight	Mushroom	Shortening, right
F. B. 4488	5¼	M	Limp 2 months	Left	Abduction Internal rotation	Slight	Mushroom	Slight limp and limitation
F B. 1220	5¼	M	Limp 3 months	Left	Abduction Internal rotation	Slight	Cap	End-result not reported
W. C. 4925	5½	M	Limp 3 months	Right	General	Slight	Mushroom	Very slight limp and limitation
E. E. 2551	6	M	Limp 6 months	*Both*	Abduction Internal rotation	Slight	Cap	Perfect motion. Shortening, right.
W. L. CCC-163	6	M	Limp 1 year	Right	Abduction Internal rotation	Slight	Cap	Very slight limp and limitation
C. M. 3832	6½	F	Limp 6 weeks	Right	Abduction Internal rotation	Slight	Mushroom	Very slight limp and limitation
R. H. 6254	7¾	M	Limp 3 months	Right	Abduction Considerable spasm	Slight	Mushroom	Present case
O. M. 3023	8½	M	Limp 2 months	Left	Abduction marked Slight general Slight spasm	Slight	Mushroom	Perfect
L. A.[1] 6176	8½	F	Limp 3 months	Left	General limitation Spasm, slight pain	Slight	Mushroom	Lengthening, left
E. M. XX-338	9½	M	Limp 7 months	Right	Abduction	Slight	*	Slight limp and limitation
R. C.[1] AAA-71	11	M	Limp 1 month	Right	Considerable general limitation	Slight	Mushroom	Perfect motion. Shortening right
E. P. EEE-48	11	F	Limp 1 year	Right	Slight general limitation	Slight	Mushroom	Perfect
E. E. 5437		M	Limp 3 weeks		Considerable general limitation Slight spasm and pain	Slight	Mushroom	Slight limp and limitation

[1] G. D. Nine months prior to disease had an abscess in groin; healed without treatment. Had apparently no relation to affection in hip.
[2] E. L., A. D., L. A., R. C. Lengthening or shortening may occur.
* X-rays broken in moving. Classification into types of head made subsequently to loss. There is a noticeable preponderance of the mushroom type of epiphysis in this group. It is constant in females, and rather generally associated with general limitation and spasm. The number of perfect recoveries is lower in this group, recovery with the slight deformity noted occurs in all cases, however.

The third group, "Cases of Operative Trauma" must naturally come under a distinct head. The process of reduction of congenital dislocation of the hip by manipulation is very generally a process involving no small frictional strain upon the epiphysis and upper diaphysis of the femur. In these cases, the reduction was accomplished with difficulty and several manipulatory operations were required. Variations in this group hardly need be considered, for they are determined primarily by the initial deformity and bear no relation to the flattened condition of the epiphysis with its correlated neck variation. The congenital dislocation of the hip is notably more frequent in female children, and all cases in this table will be observed to be girls. The earlier age of occurrence is ordinarily determined by the time of operative interference. The constancy of the symptoms associated with flattened epiphyses of sporadic occurrence is all the more valid, however, for the condition of the epiphysis before the hip is reduced is always well known, and the resulting flattened condition is very definitely consequent upon the traumatic strain necessitated by the operative return of the femur head to the acetabulum.

CASES OF OPERATIVE TRAUMA

Record	Age	Sex	Onset	Hip Affected	Motion Limitation	Type of Epiphysis
A. C. H-58	2	F	Birth	Both	Abduction	Mushroom
M. C. D. 4688	2½	F	Birth	Both	Abduction	Cap
H. D. CCC-157	2½	F	Birth	Left	Abduction	Cap
A. M. LXIV-18	3	F	Birth	Left	Abduction	Cap
M. S. LXII-129	3	F	Birth	Right	Abduction	Cap
C. B. EE-469	3	F	Birth	Both	Abduction	Mushroom
A. S. LVIII-145	3½	F	Birth	Left	Abduction. Internal rotation	Cap
H. J. LXXIX-124	4¾	F	Birth	Right	Abduction. Internal rotation	Mushroom
F. C. WW-92	5	F	Birth	Right	Abduction. Internal rotation	Mushroom
H. D. 144	5	F	Birth	Left	Abduction	Cap
H. H. JJ-159	5	F	Birth	Right	Abduction. Internal rotation	Mushroom
C. F. 4907	5¾	F	Birth	Left	Abduction	Cap
B. B. XX-436	7	F	Birth	Both	Abduction	Cap
R. M. KK-185	7½	M	Birth	Right	Abduction	Mushroom
E. C. XLVIII-77	9	F	Birth	Left	Abduction. Internal rotation	Mushroom
N. S. 453	12	F	Birth	Left	Abduction	Mushroom
E. R. 21	12	F	Birth	Right	Abduction. Internal rotation	Mushroom

The femoral head in congenital dislocation cases is small and very much retarded in development, not only with reference to size, but in degree of lime deposition in the ossified center. The contour, however, is normal and the epiphysis well domed even where it shows a diminished radiability, probably atrophic. Such epiphyses, in addition to undergoing traumatic strain upon reduction, are already in a condition of ossification little calculated to endure pressure strain (see Figs. 7 and 8).

This group of cases of operative trauma has been particularly interesting to me because it has offered for study an experimental traumatism which can be watched throughout its course and because it presents variations in epiphyseal relation to weight-bearing which are worthy of thorough study. I find that Perthes and Brandes have in their own work also arrived at the conclusion that the epiphysis modification after reduction of congenital dislocation is of similar nature to that which occurs in osteo-arthritis deformans juvenilis, but they have not entered upon the study of these cases as helpful in determining the relation of the traumatic circulatory disturbance to the etiology of the disease.

The number of the cases studied is too great to give the detailed histories of every case; therefore, I have endeavored to concentrate into this triple chart the points which I consider essential to this discussion. The symptomatology, already given, covers all minor details, which are very constant and notes on all special variations are added.

I present in addition a group of typical X-ray reproductions illustrating the subdivisions above. Figures 3 and 4 show cases of known trauma: the former showing a cap deformity of the epiphysis, the latter the domed mushroom-like modification. Recovery in both cases has been complete. Figures 5 and 6 are of two similar cases in which trauma was not reported. Figures 7 and 8 are pre-operative and post-operative radiographs of a case of congenital dislocation of the hip. Figure 9 is a case immediately after a traumatism, in which the radiogram was secured before the circulatory changes and resultant bone modifications have taken place. The end-result in this case was identical with those above. Figure 10 is a radiograph of a case taken fourteen years after the original deformity and shows the persistence of the epiphyseal and femoral changes.

In all of these radiographs it is noticeable,

SYMPTOM-COMPLEX

Legg	Calve	Perthes	Brandes
Occurrence: 2½ to 12 years.	3½ to 10 years.	5 to 10 years.	4 to 13 years.
Onset: Appearance of a limp with frequent relation to trauma.	Variable onset, with pain or the appearance of a limp only.	Appearance of a limp.	Appearance of a limp.
Trochanteric prominence on side affected		[3]	Prominence of the great trochanter.
Limitation of motion, marked in abduction, slight in internal rotation. Flexion free.	Limitation in motion.	Marked in abduction, in varying degree in internal rotation. Flexion free.	Limitation in abduction almost total; adduction and rotation limited in varying degrees. Flexion fully free.
Capsular thickening.			
Little or no pain, subjective or upon manipulation.	See onset.	No pain.	No tenderness or sharp pain.
Little or no spasm.		No reflex muscle spasm.	[2]
Trochanter slightly above Nelaton's line. Positive Trendelenburg.		Trochanter high.[1] Trendelenburg's symptom present.	Trochanter well above Nelaton's line. Positive Trendelenburg.
Legs equal in length, with occasional exceptions.		Legs equal in length.	Shortening on affected side.
Muscular atrophy: glutei.		Muscular atrophy of glutei.	Muscular atrophy of thigh.
No crepitation.		No crepitation.	No crepitation.
Von Pirquet negative.		Von Pirquet, in general, negative.	[2]
Wassermann and luetin tests negative.			
No evidence of old rachitic condition.	Skeletal indications of rickets.	No evidence of old rickets.	No report of rickets.
Short active duration, six months to a year.	Short duration.	Short active duration.	[2]
Persistence of bone deformities.	[4]	[4]	[4]
Typical röntgen appearance: 1. Atrophied flattened epiphysis, cap-like or mushroomed in shape. 2. Hypertrophic thickening of the neck of the femur. 3. Apparent coxa vara.	Typical röntgen appearance: 1. Flattened epiphysis with marked variations in density. 2. Hypertrophic neck of femur. 3. Apparent coxa vara.	Typical röntgen appearance: 1. Flattened epiphysis with focal points of diminished density in early stages. 2. Hypertrophic neck modification of the femur. 3. Acetabular modification in accordance with the change in the epiphysis, in late stages.	Typical röntgen appearance: 1. Flattened epiphysis, domed or platelike. Variations in density. 2. Hypertrophic modification of the neck of the femur. 3. Late acetabular modifications.

Note.— The comparative symptom-complex is intended only to indictae the extreme similarity between the points of diagnostic value which have been brought out by various writers on this subject. Points omitted in the second, third, and fourth columns, as shown in the following special notes, are often not given because I have not felt at liberty to insert into their syndrome, points from the general text of the writers quoted.

[1] This point as given by Perthes covers the prominence of the trochanter possibly as well as the elevation.

[2] Muscle spasm is discussed by Brandes particularly in connection with the disappearance of the spasm under anæsthesia. Perthes refers to spasm in the same connection. Similarly, in my own text, spasm immediately after trauma as related to the bone modifications is discussed. Both pain and spasm are incident in general to injuries but they are not in my experience persistent characteristics of this affection of the hip-joint though possibly they are very frequently attendant upon the trauma which is the producing cause. Von Pirquet reactions and the duration of the disease are both treated by Brandes in the general text.

[3] See[1] above.

[4] The persistence of the bone modifications is axiomatic I believe and only omitted by other writers as a point obvious in itself which requires no special discussion.

as Perthes has also observed, that the displacement of the epiphysis is upward and outward, in place of inward and downward as occurs in epiphyseal displacements of the type reported by Weil, which amount to actual fractures and frequently produce one type of coxa vara.

The change in shape and position of the upper epiphysis is, I believe, related to the limitation in abduction which is so constant. Both Perthes and Brandes do not believe the limitation is caused by the deformity, because they find that under anæsthesia free abduction returns. My own results do not strictly accord with their statements. Anæsthesia in many cases does not remove the limitation.

It seems most probable, in view of the data from all sources, that muscular limitation is primarily the cause of the deformity, in place of its result, particularly where trauma is by demonstration or hypothesis the etiological factor. A traumatism which produces a

muscular limitation in abduction, an adductor spasm, by persisting during a period of disturbed ossification, with vascular regeneration and redeposition of calcium mechanically would result, in all likelihood, in just such structural modifications as occur in the epiphysis. The adductor contraction is, I believe, responsible for the initial limitation in motion, and so far as I can determine by clinical and röntgenological study is related, as I have just suggested, to the production of the bony deformity. The osseous modification, upon becoming permanent, however, creates a secondary persistent limitation in abduction, which is determined, at least in part, by the positional and shape modifications of the femoral epiphysis and neck.

The thickening of the neck of the femur, which shows in the radiograms, is quite distinct from the synovial and capsular thickening, which is palpable. The decreased radiability or greater shadow density of this region and the associated increase in spherical diameter is, I believe, partly due to bone increase through periosteal activity, such as occurs in callus formation in more serious cases of trauma. An appearance of coxa vara is the result, a modification not due to any real bending of the femoral neck or lipping of the epiphyseal margin of the diaphysis, but is a uniformly widening bone layer which increases proximally. This increase is more apparent on the under surface where it diminishes the obtuse angle of the shaft and neck. I show this in the accompanying diagram (Fig. 11), in which the original femur is presented in black, the bone addition and the positional and morphological modification of the epiphysis is shaded in with cross lines. The widening of the new-bone formation toward the epiphyseal line is as nearly as possible in direct proportion to the increased density of the radiographic shadow. Just below the epiphysis in the diaphysis, there are frequently areas of increased radiability similar to those occurring in the epiphysis itself. These indicate areas of diminished resistive strength to pressure and result often in a slight rounding off of the upper diaphyseal angle (see *a* in Fig. 11), or possibly in a flattening such as occurs in the head.

All of the observations on osseous modification are röntgenological. There is never a necessity for operation in the disease, and as the affection is never fatal a study of the changes at autopsy must remain unaccomplished until determined by fortuitous circumstances.

The two distinct types of end-result of the deforming process in the epiphysis are interesting. The cap deformity seems to follow irregular disturbance in the ossification, which produces regions of extreme radiability alternating with areas of undisturbed ossification. These are described as "bony islands" by other writers. The mushroom shape apparently results from evenly distributed atrophy, as though lime absorption occurred uniformly throughout the epiphysis, and that under evenly distributed pressure on a body of lessened resistance the entire epiphysis had flattened. Two such forms would be logically expected from a circulatory disturbance: the former occurring where the blood-vessels were occluded only at points, the latter where the disturbance was general. The fact that ossification is renewed in the cap type by the reappearance of lime about the margins of the "bony islands" until these grow together and become welded into a continuous ossified mass is very interesting since, hypothetically, at least, it could be related to the regeneration of the capillary system from the vessels which remained intact in the areas of undisturbed ossification. I advance this at present as a suggestion only.

The traumatic conception of etiology is excellently supported by the history of the disease itself. If one reviews the facts of occurrence and course, it is found that a spontaneous affection in a joint arises without so far as can be determined any systemic or infectious disease-producing cause. An initial mild acuteness, as far as symptomology is concerned, passes through a gradual self-reparative process and gives generally an end-result, frequently without any assisting treatment, of a slight persistent limp and motion limitation, or a perfect recovery. Such a combination of onset, course, and end-result, is typically traumatic, and the strictly accessory nature of the treatment is quite

similar to that which is possible in cases of more serious traumatism.

Concerning the treatment of this affection of the hip, there is very general agreement among all writers. From the time I watched the course of my first case, it has been my opinion that very little treatment is necessary. In milder cases, results have been equally good with or without immobilization. A simple flannel spica has been used in many of these. On severer cases, especially where there is spasm or great limitation of motion, a plaster spica should be applied. The healing process tends to come about naturally and by watching the patient and affording any accessory which diminishes strain upon the hip to facilitate recovery by means of repair, is all that can be done.

The osseous modifications in the hip during this repair, as observed röntgenologically, lead to an end-result of deformity which is permanent. The slight limp and motion limitation, as reported in cases in my charts after recovery, is associated with this persistence. The case of J. M., LL 192, has been observed for fourteen years and the most recent röntgenograph, taken March, 1915, at the age of nineteen is given.

Of the supposition advanced by certain contributors to the literature that liability to this disease is hereditary, I find no support in my clinical experience. It is probably true that certain individuals are more liable to marked results from injury than others. Exactly as the lime composition or a slight variation in shape, combined with a trauma, influences the degree or even the occurrence of a fracture, individual variations in the shape or positional relations in the hip would be a factor determining the result of a sudden impact. Familial occurrence of the disease, in its occasional report by others, may be related to such a variation. The occurrence in children of exuberant vitality and the predominance in males coördinate the disease with personal activity and participation in violent sports and associate sporadic duplication of the disease in families with habits of life rather than hereditary tendency. Fractures studied in the same fashion would give an equally familial distribution.

The proportionate occurrence in boys is very marked in all reports and lends supporting circumstantial evidence to the idea of traumatic origin. In my cases, in those of known trauma, the proportion is nine to one; in the negative group, two to one; Brandes' proportion is seven to three; Perthes', four to two in one group, and thirteen to two in the other; cases from Waldenstroem's group give the ratio of four to one; Calvé's, four to one; Delitala's, eight to zero.

It is upon his idea of origin that I feel obliged to differ very radically from the last-named writer. The idea of a "congenital alteration, either of the epiphyseal cartilage of the upper end of the femur or of the epiphyseal nucleus, which gives way to processes of ossification which are insufficient and irregular" which is largely restricted to males and develops at varying ages in childhood without prior indication of the existence of such a condition, is not within the range of acceptance of my clinical study and treatment of the disease.

Modern research along Mendelian lines does substantiate, in germ-cell qualifications, transmission of characteristics in one sex only, but the appearance of a congenital lesion unrelated to any of the special phases of life, such as adolescence, has very little foundation, and the close regional association of atrophy and hypertrophy is as drastically opposed to the idea of a congenital systemic affection, as it is favorable to the conception of a circulatory lesion, traumatic in origin.

The case of my own which was most interesting to me in the study of the disease was the one of J. K., ZZ-324, in which an X-ray taken immediately after the trauma presented an absolutely normal hip. In the course of a few months the typical bone changes were present. I am not ready to present this case, as strong as the evidence is to me, as forcibly as it deserves, for the reason that in moving the plates of the hospital from the old location to the new building, the later plates were destroyed and I have been unable to replace the final plate giving the end-result which would still be possible if the child could be traced. The original plate and the history of the case are still in our records, however.

Waldenstroem in one of his cases (17), without reporting a trauma, presents the radiogram immediately after a limp of one week's duration as normal and shows later radiographs with flattening of the epiphysis and changes in radiability.

The rare cases in which the affection is bilateral, which have occasioned considerable speculation, are not inharmonious with the traumatic production of circulatory lesions. The arms are very rarely affected in the same way by a fall or accident of any sort; in many instances, however, the legs receive the impact of a fall similarly and simultaneously. Such a jar is always incident to a false landing from a high jump and to falls which throw a child on the knees. Circulation is noticeably more strictly bilaterally symmetrical in the distribution, in the size of vessels and current maintained, in the lower half of the body where use of the muscles and nerves related to vascular control are associated with symmetry of function. Though such an accordance between the possibility and the occurrence has no direct weight upon the acceptance of the hypothesis, it is at least wise not to attach one's opinion to an explanation of disease which cannot be brought into accord with all the known facts.

Occasional secondary infections occur in cases of this disease. Waldenstroem's idea that the local circulation determines the lesion in the hip is correct though these lesions are not early tuberculosis. Calvé's suggestion, as already quoted, that "regions of lessened resistance" establish in the hip points of appeal for light customary infections, in some few cases is true, but the lessened resistance is determined by trauma, as I see it, instead of by rickets. The onset of such symptoms of infection is strictly secondary, occurring some months after the original disturbance. In no instance have I found the apparent renewal of disease to be tuberculous.

It is from the point of view of differential diagnosis that the etiology of the affection is most important. The thorough understanding of the nature and possibilities of circulatory lesions due to trauma in the hip makes the separation of these cases from early tuberculosis very simple, and, as the treatment for the two affections differs widely and it is important that tuberculosis should have correct treatment early, every step which differentiates more clearly other affections by elimination makes the diagnosis of tuberculous coxitis more secure. The immediate report of these cases after trauma may reduce the resultant deformity, if adequate protection from pressure on the epiphysis can be secured, a result which equals in its value to the individual, the more general professional gain to the diagnostician.

The present evidence from all sources is that, in general, the cases do not report until the limp is established. Should the medical profession succeed in associating this permanent though slight deformity with traumatism to the hip, earlier reports of the cases might result and genuinely perfect recovery without slight limp and motion limitation would be more frequently secured.

In spite of the long series of names which have been attached to this disease, in behalf of the conception of etiology which is important both to diagnosis and treatment, it is my desire to suggest a change of name to accord with the etiology. Having thought considerably on the subject and discussed a varied nomenclature with many members of the profession, osteochondral trophopathy appears to condense as much as possible a name descriptive of the characteristics of the disease and seems no more complicated than the terms already applied to the affection. Analysis of the words employed makes unnecessary any explanation as to their selection.

In conclusion, I wish not to summarize the cases presented, nor to discuss questions of symptomatology and treatment, but to emphasize as much as possible through my work, the importance of an etiology which is entirely in accordance with clinical data and which has for a number of years proved serviceable in diagnostic work.

I wish to extend my grateful acknowledgment to Dr. S. Burt Wolbach of Boston for the suggestion of the name which has seemed most suitable to me; to Dr. Percy Brown of Boston for the excellent röntgenological end-result secured in the case of J. M., Fig. 10;

and to Mrs. A. M. Anderson, who has rendered invaluable assistance in the construction of the paper.

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DEATHS ATTRIBUTABLE TO INTRANASAL OPERATIONS AND OTHER INSTRUMENTATION

A Critical Review with Report of Eight Unpublished Cases, One Personal[1]

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THAT death should follow cauterization of the nasal mucosa, or after diagnostic puncture, irrigation, or perflation of the antrum of Highmore is surprising and not to be expected, as thereby violence is not done any vital structure, nor are any channels laid open for the transmission of toxic material, especially as in the latter instances death was almost instantaneous. On the other hand, it is still more surprising that more deaths do not occur after such instrumentation as probing the various sinuses, the attempted introduction of cannulæ and the curettement of them, or from operations on those structures and the bony septum, when their intimate connection with the cranial cavity and the meninges is recalled, not only through the medium of the blood vessels and lymphatics, but also by actual continuity of tissue. Moreover, when it is considered that removal of the middle turbinate, itself but a wing of the ethmoid labyrinth, lays bare numerous new channels for the transfer of infective material straight to the meninges by way of the porous and poorly resisting ethmoid, the ensuing death should never surprise, however much it may distress, the conscientious attendant. Similarly, the removal of nasal polypi is singularly free from danger, as a rule, when it is fully appreciated what their presence signifies, as it is fairly certain that the periosteum always and the subjacent bone nearly always are diseased. Consequently, to disturb this necrotic area with the added hazard of trauma (as most polypi are thus removed: avulsion) must set free infection in the presence of new areas for absorption in a region that is always dangerous: the middle and superior straits of the nasal chambers. The most elementary knowledge of anatomy would cause appreciation and respectful consideration for the dangers of any operation on the bony nasal septum, especially any that encroached upon the ethmoid perpendicular plate, and the radical frontal sinus operations are so obviously critical that deaths from this latter class are not even considered here, save in one case where the fatality was directly due to the removal of the middle turbinate and disturbance of the ethmoid in the presence of an acute suppurative ethmoiditis and frontal sinus empyema. When infection does occur it is to be accounted for not only by the virulence of the bacteria, but also by the laying open of wide venous and lymphatic spaces with their free communications with the subdural and epidural channels. The intimacy of this relation has been shown clearly by Schwalbe, Michel, Key and Retzius, and Cunéo and André, who severally show that the cribriform plate of the ethmoid is the point of communication between the nose and the dural spaces, either by the venous or the lymphatic route, and by the fibers of the olfactory nerve. Logan Turner is rather skeptical as to the responsibility of the lymphatics for the spread of infection in the nose, and he quotes Gerber, Gyselynck, Mayer, Hoffmann, Hoguenin, Ogston, and Warner, all of whom report a series of infections from empyemata of the accessory sinuses, which would seem to show, in the main, that the lymphatics conducted the toxin less often by far than any other method. Ortmann's case, for example, reveals the infection as spreading by continuity of inflammation through bony walls.

The comparative freedom from fatal infection following operations within the nose has encouraged considerable speculation and theorizing as to the cause of this immunity, some of which are as follows: a special bactericidal power on the part of the nasal mucus (2), that it is a poor culture medium for bacteria (3), its mechanical function in agglutinating the bacteria and preventing

[1] Read before The American Academy of Ophthalmology and Otolaryngology, October, 1915.

their activity (42). Certainly the film of thick secretion that exists over the nasal mucosa does act as a protective curtain against dust and other foreign bodies, and it is not entirely unreasonable to attribute this same effect where bacteria are concerned. However it may be construed, we know that regions which are necessarily exposed to trauma and infectious agents are by nature afforded greater powers of resistance than elsewhere in the body, and the nasal mucosa is peculiarly active in this respect. While it might be supposed that the use of cocaine would obscure the etiology of these fatal cases, yet not one could be fairly stated as due to its use, though Claus gives it as the cause of his two cases (12). However, there can be no doubt but that the use of adrenalin (4) was directly the cause of several fatalities, one of which I will give later, as a personal observation at the hands of a colleague in this city. The number of authors who have testified to its dangers is great, and Lermoyez and Aubertin have tried to eliminate the peril by fixing the amount that it is safe to inject in nasal operations. Such an attempt is futile, inasmuch as an idiosyncrasy for the drug might prove fatal. The careful investigations of Lévy and Cannon and Hoskins seem to establish the fact that light chloroform narcosis (as opposed to deep) is peculiarly fatal often when adrenalin is injected; and it is so used just at the beginning of the primary stage, to save the operator a few moments' time. I have seen it so used and result in speedy death. This indefensible desire to save time would appear to be rather common, as it is given especial attention by Jacobs and other anæsthetists in their articles. The absorption of many drugs, but preëminently adrenalin, is very rapid when injected, or even applied topically, in the nasal mucosa; in fact, when injected into the turbinates, especially the middle, absorption is more rapid than from any other region. Pilcher has demonstrated this fact in the course of extensive experiments. The deaths that do occur from chloroform anæsthesia, independently of the use of adrenalin, Lévy has shown to be due to cardiac fibrillation, and that adrenalin also can cause this same fibrillation. Again, von Anrep and Starling have shown that the rise of blood-pressure seen in asphyxia is due to the increased amount of carbon dioxide, which in turn increases the secretion of epinephrine. To cap this climax of hazard, Cannon and Hoskins testify that fear and sensory excitation greatly increase the activity of the adrenals! How does any patient escape death who has a submucous resection done under chloroform, in the early stages of which narcosis adrenalin is injected into the septal mucosa? Certainly the operator has placed his patient's life in grave and unnecessary jeopardy.

DEATHS DUE TO ADRENALIN

1. Hubbard reports the case of a colleague in which the adrenalin was injected into the turbinate under ether-chloroform anæsthesia, and death was very speedy. In the light of the preceding facts about anæsthesia, it is not surprising, especially as the patient was verging on nervous prostration, which introduced a still worse complication.

2. Under the belief that the death was due to the status lymphaticus, Harris reported a case of removal of the tonsils under cocaine-adrenalin infiltration in which the death was almost instantaneous. However, in the discussion that followed the reading of the paper, Harris admitted that perhaps the adrenalin was actually the cause of the death, despite the finding at autopsy of a thymus weighing 18 grammes. In this opinion I concur, as did Swain and Hubbard most vigorously. The right heart was filled with fluid blood till the auricular appendage was five times the size of the left. Thus I am reporting the case as one in which the death was due to the adrenalin, of which he received about 8 to 10 minims, and of cocaine 1/12 grain.

3. Freudenthal had a patient die after the injection of 10 drops of adrenalin.

4. A reputable rhinologist of this city lost a case, which he was about to operate upon for deviation of the septum, within three minutes after the injection of adrenalin. The case was that of a young man, who approached the operating room in some distress of mind, and while just barely under the influence of

the chloroform the adrenalin was applied. Almost instantly he was observed to be in distress, his breathing shallow; soon the pulse was impossible of detection, then the lungs ceased action. This case has not been published.

DEATHS FROM HÆMORRHAGE

1. I saw a patient of a colleague die from hæmorrhage of the middle meatus in the extraction of a sarcomatous tumor. He was nearly 55 years of age, and the sarcoma well developed, though it might be possible that asphyxia was the immediate cause of death, as the preliminary tracheotomy and tamponnade of the larynx were not done. The blood in great quantities flowed into the lungs, as the hæmorrhage was unusually profuse owing to the method of attack employed by the general surgeon who performed that part of the operation. The floor of the nasal cavity was severed from the upper part by a horizontal incision made at the gingivolabial line, giving a free view of the growth, but adding alarmingly to the loss of blood. The case has not been reported.

2. In his paper on nasopharyngeal growths and the complications attending their removal, Sczmurlo reports the loss of one of them through hæmorrhage.

3. According to Lémeré, Gerdy had a similar unfortunate experience in removing polypi.

DEATH FROM PACKING NOSE FOR EPISTAXIS

1. Hayen packed a nose with gauze saturated with a solution of perchloride of iron and saw his patient die some hours later from meningitis. The post-mortem showed this inflammatory process plainly, but also showed the path the infection followed, proving that the olfactory nerve-fibers do transmit infection through the cribriform plate to the meninges. The whole length of the olfactory sulcus was stained with a brown discoloration which continued throughout the nerve paths to the meninges.

DEATHS FROM PUNCTURE, OR INJECTION OF AIR OR FLUIDS INTO ANTRUM OF HIGHMORE

1. Neuenborn reports having seen the death of a colleague's case from irrigation of the antrum, which he thought due to the cocaine, but the manner of the death, which was almost instantaneous, excludes this cause.

2. A patient who had had the frontal and maxillary sinuses irrigated before with no signs of distress, at the next visit suddenly collapsed, and soon died when the same procedure was attempted. Such is the report of Henrici, as given in Kelly's paper. The frontal sinus could have had no part in the fatality, as it lacks the reflex which the antrum possesses, and which I believe to be the cause of such deaths. Henrici speaks of the death as due to, or following, an epileptiform seizure, provoked by the shock of the treatment.

3. Hajek's patient was a diabetic who also had arteriosclerosis and was of advanced years. The trocar was introduced beneath the inferior turbinate and the fluid injected for the relief of an empyema. He immediately collapsed, developed a left hemiplegia and soon after died (36 hours) from cerebral apoplexy.

4. Kelly's patient complained of feeling a tickling sensation in his larynx when air was blown through the antrum, and he had an immediate paroxysm of violent coughing, lying prostrate for 45 minutes. A week later, the air would not go through the ostium and he tried to force it, whereupon the patient's head fell forward and he said the same tickling was present in the larynx and down the arm of that side. He then fell forward unconscious and remained so for 3 hours, when he complained of pain in the arm and leg, and the leg seemed to be convulsively twitching. He died in 14 hours.

5. In a case showing suppuration of the maxillary, frontal, and one sphenoid sinus and polypi, Kelly had already removed the polypi and entered and washed out several times the antrum through the alveolar route. At this treatment he merely inflated the cavity, and was astonished to see the patient's head fall forward, and the patient become unconscious. A little later a convulsion developed and he died in 40 hours.

6. A case which Claus had twice before irrigated, on the third antral irrigation sud-

denly became cyanotic and died. He incorrectly attributed this to the use of novocaine. The autopsy revealed nothing abnormal.

7. His second case died several hours after puncture of the antrum and insufflation of air; again, he wrongly gives cocaine as the cause of death. The autopsy showed minute hæmorrhagic spots in heart, lungs, and brain.

8. One hour after puncture of the antrum, Bowen lost a case, whose death he gives as due to an embolism of the pulmonary artery. This was shown at autopsy, as well as the immediate cause of it: the passage of the trocar behind the antrum, separating the periosteum from the bone and wounding the vessels there.

9. In Killian's clinic a patient died immediately upon his antrum being irrigated. Killian thought the low temperature of the injected fluid responsible for the death, as it shocked the patient.

10. Culbert punctured a patient's antrum and a septic pemphigus developed soon after. In two weeks the patient died.

The only rational explanation for the sudden deaths that occur in this connection is a reflex irritation of the vagus which can be accomplished by an irritation of the second branch of the trigeminus which supplies the antrum and communicates with the vagus. Killian, Hajek, and Félix all agree on this point, and Killian presents the additional fact that in many the irritability of the trigeminus is much greater than usual, and thus the more likely to give the reflex. Moreover, the series of experiments conducted by Kretschmer, Knobloch, and Röder seem to prove this method of heart arrest entirely possible.

DEATHS FROM PROBING AND IRRIGATING FRONTAL SINUS

1. Weigest (quoted by Vohsen, 9) reports a case of fatal meningitis due to an injury to the dura, made by an attempt to make an application to the frontal sinus. The autopsy showed that the applicator had pierced one of the sinus walls.

2. Mermod was so unfortunate as to attempt to introduce a cannula into the frontal sinus of a hydrorrhœa nasalis case, both of whose sinuses at autopsy proved to be absent. The injury to the dura and brain caused in 6 days a fatal meningitis.

3. Forty-eight hours after the injection of an antiseptic solution in the frontal sinus, Ingals lost a patient from meningitis. He had previously opened the nasofrontal duct intranasally, and had been for a week irrigating the sinus with a mixture of hydrogen peroxide and boric acid solution. On this occasion, as the flow of pus seemed to continue profuse, he used more force than usual in an attempt to reach the deep origin. Suddenly the patient complained of pain and became unconscious. Apparently the great atrophy of all the nasal structures, which was marked in this case, extended to the walls of the sinus in the deep recess of which, over the orbital plate, was a collection of inspissated pus. This under the action of peroxide caused a sudden and violent pressure, with opening into the meninges.

DEATHS FROM REMOVAL OF POLYPI

1. Merckx's patient died 4 days after the removal of a polypus, from meningitis. He thinks there was a latent meningitis some weeks before operation, as she complained of headache and fever, and her disposition had altered markedly.

2. According to Lémeré, Demarquay lost a patient from meningitis after the avulsion of a polypus.

3. Voltolini's case died from septicæmia after a similar operation.

4. Despite his care in doing the operation in several sittings, Réthi lost a patient from meningitis following the removal of several polypi.

5, 6, 7. Heymann mentions 3 deaths at the hands of reputable rhinologists in Berlin from this operation.

8. Twelve days after operation Tawse lost a case from brain abscess.

9. Broeckart lost a case similarly.

DEATHS FROM ETHMOID CURETTEMENT

1, 2. Tawse lost two cases, one 7, the other 4 days after operation, from meningitis.

3. Five days after a partial curettement

of the ethmoid labyrinth, Hajek lost a patient from meningitis. The removal of the middle turbinate, which preceded this operation, had no effect in causing death, in my opinion.

4. Hinsberg lost one case from simple curettement.

DEATHS FROM TURBINATE OPERATIONS

1. Removal of the inferior turbinates resulted in death in Gregory's case, though the autopsy showed a fractured ethmoid cell, which might have caused the terminal meningitis.

2. Kümmel's case died from the result of a tear of the dura and a fracture of the cribriform plate, apparently caused by the removal some time before of the middle turbinate. The injuries were not discovered till after death from what was supposed to be an acute frontal sinus abscess. The autopsy revealed the basic trouble and cause of the cranial involvement.

3. The danger of removing the entire middle turbinate in acute frontal sinusitis without first trying the ordinary irrigation is illustrated by the death in the practice of a colleague of this city. The advanced age of the patient made her an especially bad risk, but the ethmoid disease under the middle turbinate soon flared up into an acute inflammatory process, and she died in 4 days from meningitis. There was an external opening made into the frontal sinus, but the operation on the turbinate caused the trouble.

4. The resection of the anterior end of the middle turbinate caused a meningeal death in Merker's case, as reported by Boenninghaus.

5, 6. The classic cases of Quinlan and Wagner, each of whom lost a case from galvano-cauterization of the middle turbinate, are well known.

7, 8. Réthi, however, adds to the records a case of Lange and another of Lublinski, dead from the same cause, meningitis following galvano-cauterization of the middle turbinate.

9. My own case, unpublished thus far, was particularly unfortunate, as it was an operation of choice and one in which so little was done that the death was as shocking to me as to the family of the patient. Under ether, because of his extreme nervousness, the right inferior turbinate was resected, only to the extent of the inferior edge, about one-third of the bone being removed anteroposteriorly. In addition, with the forceps the remains of adenoid tissue were removed, a small centrally located, fibrous mass as large as the tip of the little finger. He took the ether very badly, and never regained consciousness after its administration, passing into violent convulsions the next morning and later lapsing into coma, dying the third day from cerebrospinal meningitis. A few moments after death, a thin stream of cerebrospinal fluid trickled down the upper lip, having escaped from the cribriform plate on the side operated upon. That the patient should never have come out of the ether, but passed insensibly into the unconsciousness of meningeal infection, and that this infection should have followed so insignificant an operation as indicated, strongly suggests that the patient already had a latent meningitis at operation.

DEATH FROM EXPLORATION OF THE SPHENOID SINUS

1. Emerson's attempt to curette the sphenoid sinus ended in death, because his instrument injured a vein which communicated with the cavernous sinus. A dehiscence in the lateral wall of the sinus exposed the vein to this unexpected injury.

DEATHS FROM RESECTION OF THE NASAL SEPTUM

1. Eight days after operation Hays' patient died from meningitis.

2. Alexander also lost one in a similar way.

3, 4. Miodowski's first case died in four days after operation; the second developed erysipelas on the fourth day, and died from meningitis on the sixteenth day. In the latter case, infection was traced through the olfactory tract.

5, 6, 7. A reputable rhinologist of this city lost three cases from meningitis through no fault of technique or after treatment; nor was there any pus in the nose at operation. These cases have not been reported.

8. However, there was frank pus in the nose of this case, as it was due to a chronic suppurative ethmoiditis, and the death from

meningitis which followed in five days was neither surprising nor to the credit of the operator, a man of reputation in this city. It need hardly be stated that the case has not been reported.

9. A colleague in this city quite recently lost a case from cerebrospinal meningitis in a week after operation. A decompression operation was done, which seemed to relieve the symptoms for a day. The infection was through the cribriform plate. The case has not been reported.

I wish to make especial acknowledgment of my debt to Dr. Eugène Félix, whose thorough paper and comprehensive bibliography have been of the greatest value. I have followed both rather closely, and have, I hope, been able to add somewhat to the number of cases and of observers.

That the interior of the nose is both theoretically and practically a zone of considerable danger for even the slightest instrumental interference I hope I have shown; and that the indiscriminate use of adrenalin is similarly fraught with danger in this region, when used for operative assistance, can be no longer ignored.

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SOME FEATURES OF IMPORTANCE IN THE DIAGNOSIS AND PROGNOSIS OF UROGENITAL TUBERCULOSIS

By JOSEPH FRANCIS McCARTHY, M.D., F.A.C.S., New York

In order to emphasize the importance to the urologist of viewing the bladder and deep urethra as practically a common organ, and of accentuating the intimate interrelation of the various urologic developmental centers from an anatomic and a pathologic standpoint, the accompanying illustrations are herewith presented.

Quite recently the anatomists have shown us the close association of the lymphatic system of the kidney with the ureter, of the ureter in its turn with the bladder, and of the latter with the deep urethra. The illustrations in this communication will, I think, corroborate this close association, at least in so much as it concerns tuberculosis.

The drawings were made with the aid of a straight urethrocystoscope, constructed for me by Mr. Rhinold Wappler, who has incorporated in the instrument an unique lens system, which permits of close observation with a minimum of distortion. It affords a truer picture than any similar instrument that has up to the present come under my observation.

Figure 1 shows a part of the deep urethra of a young man presenting himself with an apparently recent case of tuberculous epididymitis. The deep urethral picture reveals three dilated prostatic ducts, from one of which caseous pus exudes, while the other two ducts apparently intercommunicate. In other words there is evidence of caseous degeneration in the prostate.

Figure 2 is more typical because it shows a more advanced tuberculous degeneration in the prostate of a man twenty-four years old suffering from tuberculosis of the right kidney with invasion about the ureteral mouth of the same side.

Figure 3 was taken with the Gerringer direct telescopic urethroscope, and is introduced here because of the beautiful manner in which the bullous œdema of the floor of the bladder is seen extending into the deep urethra of a case of advanced urogenital tuberculosis.

Figure 4 is the most beautiful illustration of urethral tuberculosis observed by me. It was discovered in a patient referred for operation for tuberculous epididymitis, but because of the deep urethral picture, this was refused and instead a change in his environment advised. From a clerical position in the city he moved to the country, where after an outdoor life of two years, he shows a marked gain in every aspect, and is symptom free. The deep urethral picture in this case impresses me with the folly of operative proced-

Fig. 1.

Fig. 2.

ures of whatever character for tuberculous epididymitis without the most painstaking investigation of the deep urethra.

Figure 5 has taught me the fact, at least from a prognostic standpoint, that a patient suffering from renal tuberculosis may also be in the possession of a deep urethra that will amply repay the time spent in its observation. This is the case of a young man twenty-two years old, referred for treatment, whose chief complaint was mictional frequency, both diurnal and nocturnal, whose urine was macroscopically turbid, whose case had been considered as renal tuberculosis by one urologist, and by another equally competent specialist, as non-tuberculous in character. The urine was searched many times for tubercle bacilli with negative result. The bladder picture was normal, save for a moderate amount of tumefaction about the left ureteral mouth together with slight mucosal injection. Catheterization of the opposite ureter yielded urine that was normal. The left ureter was occluded, at least to the passage of an ureteral catheter.

Here parenthetically I should like to state that, in a young man with a history of marked frequency, a certain amount of dysuria, an urine that is macroscopically turbid, that microscopically contains pus, whose ureter is occluded, who is radiographically negative, in all human probability, we have to deal with a case of renal tuberculosis. Inspection of this patient's deep urethra revealed tuberculous focal necrosis of a pronounced character. To the left of the verumontanum there was a well defined area of caseous destruction of the prostate, while to the right was a number of enormously dilated prostatic ducts.

On the strength of these findings, the patient's left kidney was removed, and found to be in a well advanced state of destruction from tuberculosis. Following the operation the patient was sent to the country where he remained for about eight months. He returned, the picture of health, reported a gain of twenty pounds in weight, and stated he was symptom free. Cystoscopic examination was negative. The pathologic change previously reported as seen about his left ureteral mouth had completely disappeared. Had his examination at this time been limited to an inspection of his bladder, the patient's report, his general appearance, the physical characteristics of the urine, he would in all probability have been discharged as a cured patient. His deep urethra, however, gave evidence of little or no improvement from

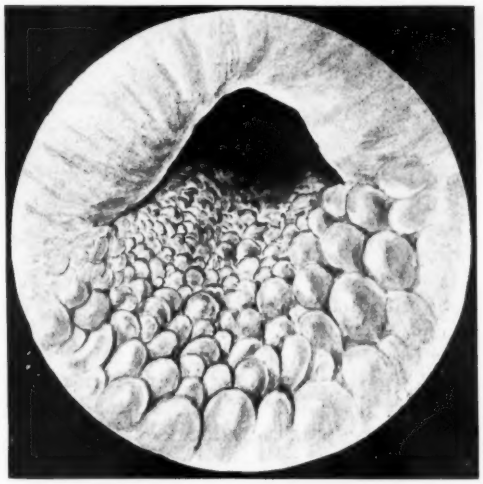

Fig. 3.

Fig. 4.

Fig. 5.

the time of the first examination. The patient, therefore, was advised to remain permanently in his new environment.

The above studies sufficiently demonstrate the fact that any instrumental examination in a case of suspected urogenital tuberculosis, is incomplete without the most careful investigation of the deep urethra. This step is important from the standpoint of diagnosis, prognosis, as well as operative indication.

In conclusion, I desire to lay stress upon the fact that operative procedures for tuberculosis on any part of the urogenital tract must ever be considered as merely the primary step in the treatment of the disease; that the operation should be looked upon perhaps as removal of the chief focus of the disease, but not in itself as a curative measure; that preliminary immunization should not be overlooked; but that above all else the patient should be considered as constitutionally a tuberculous subject, and treated as such.

Finally, in line with this idea, the time has come when the authorities should busy themselves in the organized care of "surgical" tuberculosis. For, to say to a tuberculous subject, which in effect is what the State does, "You must exercise a selective action in affording a domicile to the tubercle bacillus, inasmuch as there is no provision for you unless we find the germ in your lungs," would be laughable were it less tragic. The State should know that the least remunerative form of tuberculosis, from the economic standpoint, is the frank pulmonary type. It should also bear in mind that every "surgical" tuberculous subject is potentially a menace to his neighbor, for the reason that at any time his disease is likely to become transmissible. It should also realize that the presence of "surgical" tuberculosis, is in itself an indication of the subject's ability to focalize the disease, and all that is needed in many cases is an additional push in the form of appropriate climate, diet, etc., effectually to surmount the difficulty.

It seems therefore, the bounden duty of the city, state, and nation to correct this paradoxical situation by vitalizing the movement recently inaugurated in New York City, by Dr. John Winters Brannan, whereby the non-operative as well as the post-operative tuberculous patient is given the benefit of such sunlight, such air, such food, and such environment, as will give our people, not only the satisfaction of an humanitarian work well done, but will also in many cases convert potential wrecks into whole citizens.

ENLARGED THYMUS IN INFANCY

By J. F. HERRICK, M.D., F.A.C.S., Ottumwa, Iowa

ENLARGEMENT of the thymus gland is directly or indirectly the cause of a number of deaths. The chief symptoms during life are those of obstruction to respiration.

The upper part of the chest is encroached on behind by the spine and in front by the sternum, so the organs occupying the cavity may easily be subjected to pressure of hypertrophy of the thymus. It seems difficult to understand how the trachea, which is quite resistant because of its cartilaginous rings, should suffer compression while the non-resisting veins and the arteries are supposed to escape. May not the symptoms be partly due to pressure on other organs than the trachea?

The form of the thymus and its location varies. The original development from two separate lobes is usually evidenced by the lower pole being divided, one tongue to the right and another, often the largest, to the left. These may extend down to, and overlay, a portion of the pericardium.

The essential symptom of thymic enlargement is a respiratory disturbance simulating a foreign body in the trachea. The respiratory difficulty may manifest itself in all possible grades; from a mild stridor to a very severe dyspnœa with fatal termination. There is a difficulty in both inspiration and expiration, but the stridor seems more intense during inspiration, at least in the cases seen by the writer. In certain cases the difficulty seems lessened by lying at an angle of about twenty-five degrees as in one of the cases reported below. In others it seems as if the upright posture was most comfortable. In some cases after a fit of vomiting, coughing or crying, during which the stridor is exaggerated, there are a few minutes relief. In one case emetics were given for a time during an exacerbation which lasted two weeks because after each vomiting spell a short respite was given from the severe croup from which the child was thought to be suffering. In more serious cases the exacerbations are very severe, even just short of death. These cases often manifest asthmatic features, and often in some violent attack death comes to the relief of the little sufferer. Death may result in the first seizure, or it may come only after months of recurring attacks and even after there has been an apparent improvement.

As to the immediate cause of death, most authors attribute it to pressure on the trachea; but pressure on the vagi, the vessels, and the heart are assigned as causes. In one of the following cases there is good reason to believe that pressure on the right auricle was the chief factor.

Differentiation of the stridor of enlarged thymus from that due to a foreign body may be made by the history of a more gradual onset, slowly increasing trouble, absence of X-ray evidence of foreign body, and the presence of dullness to side of sternum, and positive evidence of enlarged gland in X-ray shadow. The differentiation from croup may usually be made by careful examination of the throat and the failure to relieve by intubation.

It is very difficult, if not impossible, to make a diagnosis between enlarged thymus and great enlargement of the mediastinal glands. The dullness in enlarged thymus is usually higher up with a notch between it and the heart area, while dullness from lymphadenitis is near the bifurcation of the trachea and great vessels. A skiagraph may assist. Also the thymic case is usually well nourished but pale and pasty, with no tubercular history. The tubercular case may be reduced in flesh, less vigorous in appearance, and may have slight elevation of temperature, all of which are absent in an uncomplicated case of pure thymic stridor.

On the question of treatment there is no very settled opinion. Extirpation is both dangerous and uncertain, especially in children. The X-ray appears to be the safest and most

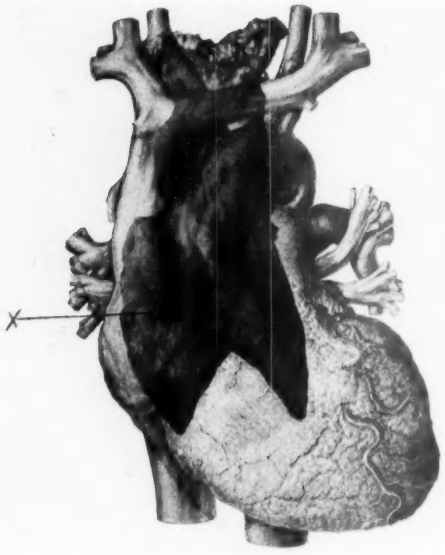

Fig. 1. Case 1. The above is a photograph of the removed thymus superimposed on a plate of the heart and vessels. The relations are correct except that the upper pole extended somewhat higher into the neck. Not being supported by connective tissue, as was that overlying the pericardium, it shrunk very much on removal. (Plate from Deaver's Surgical Anatomy.)

satisfactory method. The following cases may be of interest and are therefore reported:

Case 1. Male, age 1 year, seen in consultation, February, 1909. Several days before while playing on the bed with its father the child became quite excited and began to breath hard. As the condition continued, a search was made for a cause and a small bone button was found to be missing from the father's sleeve and it was decided that the child had swallowed the button. A physician was called but attributed the trouble to croup. The child did not improve, hence the consultation. A good skiagraph showed no evidence of foreign body in the air passage, but did show a widening of the shadow of the sternum which, with the symptoms present — stridor, cyanosis, retraction of abdomen and suprasternal space, absence of fever, etc. — led to a diagnosis of enlarged thymus. The case was treated symptomatically the condition not seeming very serious, and on the approach of spring and warm weather it became well enough to pass out of the care of the attending physician. The family moved in the meantime, and in October, 1909, the child was again brought to the office for consultation, this time by another physician. The writer

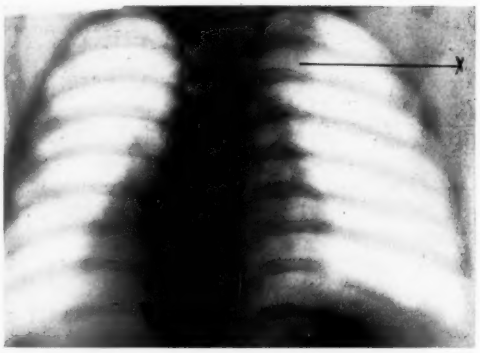

Fig. 2, Case 2. Shows shadow to right of sternum as indicated at X. (Slightly retouched.)

recognized the case and felt convinced of the truth of the former diagnosis. However, at the urgent request of the attending physician and the parents, skiagraphs were taken showing no evidence of a foreign body in the air passages.

The diagnosis of enlarged thymus being confirmed, as was believed, and the writer refusing to operate, the child which was getting worse all the time was taken to Chicago. Notwithstanding the fact that no foreign body was shown by the X-ray and that a diagnosis of enlarged thymus had been made, the symptoms were so characteristic of foreign body that tracheotomy was advised by two prominent surgeons.

The child was anæsthetized, but on the first incision for tracheotomy, stopped breathing and could not be resuscitated. No foreign body was found. The writer was permitted to make a post-mortem examination, which showed a very large thymus reaching from above the sternum down to and covering fully one third of the pericardial sack as indicated in the illustration, Fig. 1.

The right lobe of the thymus was especially thick and fleshy and lay directly over the right auricle. The left lobe somewhat longer, but not so thick, lay across the root of the large vessels. The attachment to the pericardium was so intimate that it was impossible to dissect it loose, and in removing the gland a large area of the pericardium had to be removed. At no place was there any evidence of former narrowing of the trachea or bronchi as a result of pressure. The body of the gland lay in direct contact with the trachea for about one and one-half inches from the upper pole. From there down the trachea dipped decidedly backward behind the root of the great vessel so that it would have been impossible to have pressure at this point without transmitting it through the veins and arteries which are less resistant than the trachea, even though they are sustained by the blood-pressure within.

The post-mortem diagnosis of the cause of death

Fig. 3, Case 4. Shows marked enlargement of the thymus extending to right of sternum as indicated.

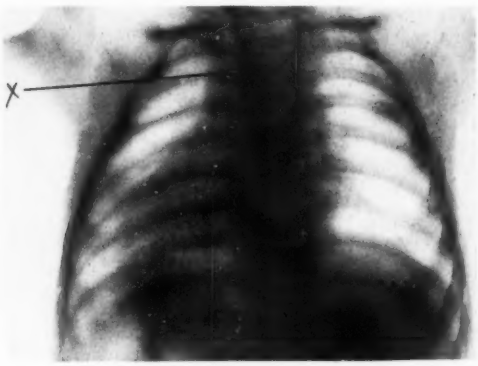

Fig. 4, Case 6. Widening of the sternal shadow to the left as indicated at X.

was: Pressure on the right auricle and probably also on the large veins about the base of the heart.

In this case any attempt to remove the gland through an incision in the neck would have failed on account of the extensive and intimate attachment to the pericardium. An effort at removal accompanied by traction on the gland, as has been recommended, would probably have proved immediately fatal through disturbance of the cardic reflexes.

CASE 2. Florence K., age 3 years, 7 months, seen in consultation, August 20, 1912. The following notes were made at time of first examination. "Well nourished, fair complexion, blue eyes, good appetite, sleeps fairly well. In March 1912, when three years old, the child was first noticed to have what was thought to be a cold, breathing somewhat croupy, slight hoarseness. There was no improvement under treatment, and the patient gradually became worse. The symptoms were not severe, however, until August 15, 1912, since which time the trouble has been decidedly worse. Examination shows a child as above, with marked respiratory stridor, worse on inspiration, especially noticeable under excitement; marked retraction of epigastrium and suprasternal space, except when perfectly quiet, then only moderate. There is a strong blowing sound on either side, back and front, over trachea and large bronchi, especially loud in region of bifurcation, no consolidation of lungs, no moist rales, but some wheezings sounds over both lungs.

"The heart is normal, the area of dullness apparently normal, but extends a finger breadth in width up to the clavicle on right of sternum. The lymphatic glands of the neck are slightly enlarged. Laryngoscopic examination revealed nothing. The child could not be kept quiet for a good picture and we were afraid of an anæsthetic (see Fig. 2). Diagnosis: Enlarged thymus; no history of foreign body and no family or personal history bearing on the condition."

X-ray treatment was advised. Two attempts were made to give such treatment within a week, but owing to the resistance of the child they were unsatisfactory. Ten days after the consultation the child died in an acute attack. No post-mortem was permitted. Personally I have no doubt as to the diagnosis.

CASE 3. Baby G., born March 1912, seen in consultation, September 22, 1912. She seemed perfectly normal at birth, grew in weight and strength until two and one half months old, when the present trouble began. The first thing observed was a slight inspiratory sound especially when excited or crying. This very slowly increased in severity although the child seemed perfectly well, grew fat and strong without disturbance of pulse or temperature. While on a visit to the country, in July, the baby developed a violent attack in which it seemed it must die. The acute trouble lasted two weeks and did not seem to be at all affected by treatment. The temperature remained normal. On partial relief from the severe symptoms the baby was brought back to town continuing to suffer as stated. She had never been sick of any other disease. When seen by the writer, September 22, the baby then six months old was normal in size, bright, interested in surroundings, in fair flesh, somewhat pale, and suffering from difficult breathing. There was marked inspiratory stridor with retraction of the suprasternal space and of the epigastrium. This had continued so long that there was a noticeable deformity of the chest. There was bronchial breathing over both lungs with crowing sound especially on inspiration. No dullness on percussion or moist rales detected.

The heart was about normal in size, but the dull-

ness as in the other cases extended up to the clavicle on the left, being about the width of a finger in breadth. A skiagraph was only a partial success because of difficulty in quieting the child. The father and mother were healthy; no tuberculosis in family except two half aunts. The child had never been about tubercular persons. The lymphatic glands were apparently normal.

Diagnosis: Enlarged thymus.

The father was a socialist who was certain the doctors were trying to fleece him so refused to let the child be treated by the X-ray as recommended. The child was living two months later but in very bad condition. The family moved away about that time.

CASE 4. G. M., male, age 4 weeks. Infant was apparently normal at birth. A trained nurse in attendance for two weeks noticed nothing unusual about the baby; nor had the attending physician. The mother, however, thought there was some respiratory disturbance from the first. During the third and fourth weeks there gradually developed a respiratory difficulty which culminated, April 21, 1914, in a violent attack of dyspnœa during which the baby almost perished. Examination showed a well nourished infant, temperature and pulse normal. No evidence of disease of the lymphatic glands or other structures on inspection. Physical examination of the chest showed very pronounced sonorous and sibilant rales over all of both lungs. There was marked respiratory stridor. Marked retraction of supraclavicular and intercostal spaces and of epigastrium during inspiration, with long and labored expiration. The breathing could be heard all over the house. A skiagraph (Fig. 3) showed an enlargement of the thymus to the right. The first severe attack proved almost fatal.

A number of severe attacks followed during the week but were of diminishing severity, apparently as a result of treatment. X-ray treatment was instituted immediately after the first severe attack. The rays were filtered through one millimeter of aluminum and one thickness of wet sole leather. The dose was about one fourth erythema dose as measured by the Holzknecht radiometer. The anterior and posterior walls of the chest were treated alternately. A treatment was given every day, the first week; then every second or third day. Later two treatments a week. In all twenty treatments were given. There was improvement from the beginning. After the first week there was no severe attacks and the child was comfortable with very little difficulty except when crying. Recovery seemed complete and has continued so until now, 16 months after treatment was started. No skiagraph was secured after the treatment was begun.

CASE 5. Louise A., age 8 months, seen first July 6, 1914. The child was well nourished and apparently well in every way except for difficult breathing; temperature and pulse, normal. She had no sickness since birth. Family history good. No enlarged lymphatics no evidence of swelling or tumor in neck. When she was one week old there was noticed a slight "wheezing" sound on inspiration. This gradually grew worse until it became very distressing. It was aggravated by fretting, crying, or slight colds. While there were severe attacks at time, the child did not appear in immediate danger of suffocation. The parents stated that no treatment so far tried, had benefited the patient. On examination there was marked respiratory stridor, with pronounced retraction of the supraclavicular and intercostal spaces and of the abdomen. Sibilant rales were present over both lungs. No dullness could be detected except to left of sternum where the cardiac dullness seemed to extend upward to the clavicle. A skiagraph also showed a shadow in this region, but not distinct enough to print.

Treatment was given as in Case 4. Very little improvement could be noticed until eight treatments were given, from which time improvement was continous; recovery was complete. Five months after the treatment was discontinued, the patient remained perfectly well. In all, there were twenty-two treatments.

CASE 6. Baby D., male, age 2 months, gives the following history. Born about July 15, 1914. In every way he seemed strong and healthy except that within a few days there began to develop slight difficulty of breathing. At first it was thought to be due to cold. The temperature and pulse were normal during the entire time. The breathing became more and more difficult, with exacerbations resulting from fretting or crying. No treatment was of avail.

On examination the baby was found to be strong, healthy, and well developed. In fact a more healthy looking child would be hard to find except for the difficulty with respiration. There was slight stridor, with retraction of the spaces and abdomen on inspiration. There were sonorous rales over both lungs; and a disinclination to active movements. The trouble was markedly aggravated by crying. The lungs were resonant except for slight dullness to left of sternum above cardiac area. A skiagraph showed a shadow in the same region (see Fig. 4). A diagnosis of enlarged thymus was made and X-ray treatment instituted as in Cases 4 and 5. The improvement was continuous from the first. When the last treatment was given, November 18, 1914, there was no stridor nor could any rales be found in either lung. The dullness to left of sternum was reduced. In this case thirty exposures were made. As in Cases 4 and 5, there has been no return of the symptoms and all three patients are well at this writing, August 1915.

Reviewing the six cases, the first case was one of enlarged thymus as proved by its clinical history and the post-mortem. In this case the diagnosis was made six months before the death of the child. In the second

case an equally clear history together with the sudden death, even in the absence of a post-mortem, is conclusive as to the correctness of the diagnosis. The third case has an equally convincing clinical history of enlarged thymus, and while living when last heard from seemed in imminent danger of death. It had no treatment.

The result of treatment in Cases 4, 5, and 6, tend to confirm the diagnosis. The diagnosis was made primarily on the history, the physical findings, and by the skiagraph. Judging by the results in Cases 4, 5, and 6, the X-ray is a safe and effective means of treatment. Larger dosage would produce a more prompt result, but the method employed was thought to give better control of the action of the X-ray.

The cases ranged in age when first seen from four weeks to three years, the average being eleven months. There were two cases in which the first symptoms appeared at one week after birth, one at two weeks, one at two and one half months, one at one year, and one at three years.

Two of the six died with practically none except symtomatic treatment. One was living under symptomatic treatment but in very bad condition when last heard from. Three were treated with the X-ray and are well.

COMPRESSION FRACTURE OF THE LUMBAR VERTEBRÆ

A Report of Seven Cases

By JAMES WARREN SEVER, M.D., Boston

COMPRESSION fractures of the vertebræ occur generally following severe violence, usually a crushing force, applied through the long axis of the spine or while the spine is flexed. Four of the cases to be reported were the results of industrial accidents, while the others resulted from other accidents not industrial, but not uncommon ones. Four cases occurred in my own practice, two are cases of Dr. R. W. Lovett and one a case of Dr. J. S. Stone, to whom I am indebted for the privilege of reporting them. The condition was rather forcibly brought to my attention by seeing two cases on consecutive days. One was diagnosed as Pott's disease, and one as back strain. The X-rays showed definitely the character of the lesion.

OCCURRENCE

The frequency of compression fractures of the spine varies directly with the different elasticity of the different regions of the vertebral column. The elasticity of the spine depends largely on the intervertebral discs, and it varies directly with the relative thickness of these discs, so that the most frequent site of injury would be in the dorsolumbar and lumbar region. Fractures of this type occur as a rule only in those portions of the vertebræ which have a supporting function, that is, the bodies. The bodies may be crushed or flattened evenly, more on one side than the other, and more in the anterior portion than the posterior, depending on the direction of the application of the crushing forces. As a rule they are more compressed anteriorly than posteriorly. More than ordinary violence may also lead to a lateral displacement of the spine as a whole above the site of the injury.

Indirect force may produce a fracture and cause displacement of the fragments of the vertebræ, so as to compress the cord or divide it. Falls on the buttocks, shoulders or back, or landing on the feet from a height, combined with extreme flexion or hyperextension of the trunk, are adequate methods for producing

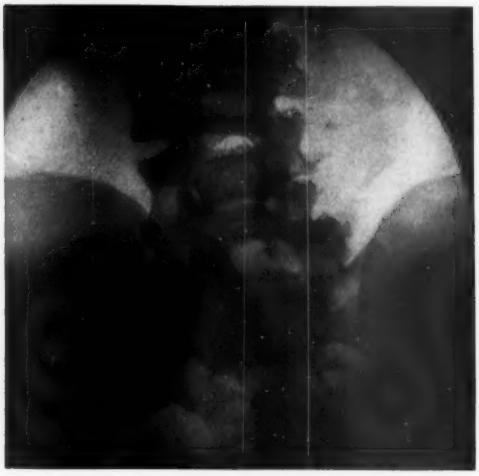

Fig. 1. X-ray, Case 2 shows the fifth vertebra crushed and crowded to left side in relation to sacrum.

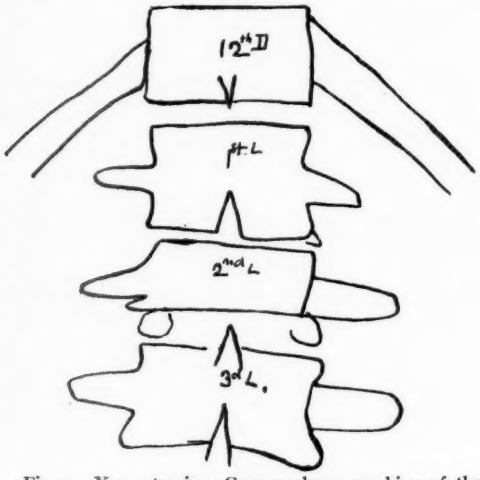

Fig. 2. X-ray tracing, Case 3, shows crushing of the body of the second lumbar vertebra.

Fig. 3. X-ray, Case 5, showing compressed fracture of the fourth and fifth lumbar vertebræ, with lateral deplacement of the fourth and fifth, so that spine as a whole above injury, is carried to the left.

Fig. 4 X-ray, Case 6, showing crushing injury of the second and possibly the first lumbar vertebra.

such a condition. When several vertebræ are crushed a kyphos may exist, but may or may not when only one body is injured. Three cases in this series presented rather marked kyphoses of different types following the crushing of but one body.

The cord, ending as it does at about the level of the first lumbar, is apt to be uninjured. Œdema and hæmorrhage about it may lead to temporary paralysis from pressure, but the symptoms from this usually clear up soon. In case the cauda equina is crushed or injured we might reasonably expect a partial regeneration of the nerve-roots, the physiological and histological evidence of such power of regeneration being strongly in its favor.

CASE 1. E. C., male, age 23. Injured by a fall of about twenty-two feet, in October, 1910. He landed on his feet on a concrete floor, and then fell over on to his side. He was able to get up on to his feet, and walked to his home some distance away, being helped by a friend. On reaching home he had to sit down because of weakness in his legs. He went to bed, where he stayed for three weeks. During this period he had several physicians, all of whom gave him pills but no physical examination. He had no bladder or rectal incontinence, he was able to move his legs freely at all times, and his sensation was unimpaired.

He complained of considerable pain in the back, especially on attempting to turn in bed. He was able to get about eventually with a cane, but had considerable difficulty on account of a fracture of the cuboid bone of one foot, sustained at the time of the fall. When I saw him, three months after the accident, he complained of inability to stand up straight without having pain in the lower part of the back. He also stated that he got easily tired after standing or walking. He could not sit up straight in a chair.

Physical examination showed a short, well developed and nourished man. He stood in a slight stoop position, and walked with a slight limp of the left leg. The back showed a slight lateral curvature, convex to the right in the thoracic region and convex to the left in the lumbar region. There was tenderness on pressure over the lumbar vertebræ, beginning at the first lumbar vertebra. The spinous process of the first lumbar vertebra was slightly more prominent than the others, but not to an abnormal degree. There was no tenderness on pressure either side of the spinous processes, over the line of the transverse processes on either side. The motions of the back in forward bending were guarded and stiff, and he could not bend forward more than about 60 degrees from the vertical. Side bending was about normal. In picking objects up from the floor he exhibited a condition of the spine commonly seen only in tuberculosis of the spine, and due to injury or disease in the vertebræ. He had great difficulty in lying down on the floor and in getting up. There was a slight backward bowing of the spine at about the region of the first lumbar vertebra, which may have been caused by a slight increase of the normal forward lumbar curve. The reflexes were normal, and the sensation over the

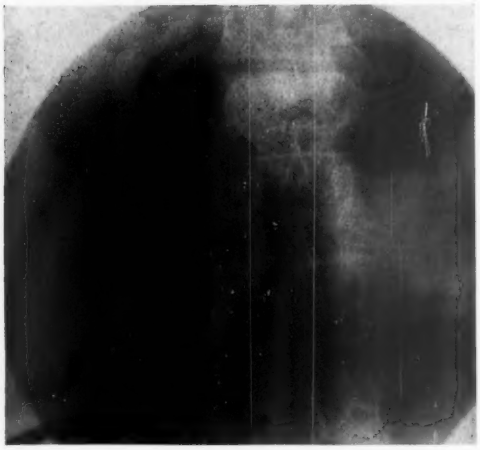

Fig. 5. X-ray, Case 7, showing crushing injury of first lumbar vertebra.

trunk and legs was normal. X-rays taken showed a crushing together of the bodies of the second and third lumbar vertebræ, besides a fracture of the transverse process on the right of the first lumbar vertebra.

This man was evidently practically incapacitated from doing any further hard laborious work, such as he had been accustomed to do, and needed a definite and adequate support to his back. Such a support, either a jacket or a brace, would have made him much more comfortable and enabled him to do some work. It was surprising that he had no more pressure symptoms on his cauda equina than he had, for the extent of his fracture must have caused considerable hæmorrhage and œdema.

CASE 2. L. P., age 20. This patient was caught under an electric car on July 2, 1910, and doubled up. He stated that in an attempt to back the car off him he felt something give way in the lower part of his back and he lost consciousness at once. He was taken to a hospital, where he stayed a week, and then home, where he stayed in bed for two months. He then began to sit up in bed and in a chair, and later began to walk with crutches. Since June, 1911, he has walked with a cane. On moving he occasionally feels a click in the lower part of his back, which causes pain, but its occurrence is becoming less frequent. He has had no paralysis of the legs, and no involvement of the bladder or rectum.

Physical examination showed a young colored man, under sized and not robust. He walked with a slight and varying limp on the right, and could walk without a cane. He could go up and down stairs freely. The spine showed a slightly exaggerated hollowing just above the pelvis. He had a rather marked right dorsal left lumbar scoliosis. Side bending and rotation of the spine were not specially restricted. The forward bending was sufficiently free to allow reaching to within an inch of the floor without bending the knees. There was, however, a peculiar click in the lower part of the spine, produced usually by straightening the spine after it had been bent forward or backward. This click was to be heard plainly, but by touch could not be definitely located. The reflexes were normal. There was no impairment of motion or sensation.

The X-rays (see Fig. 1) showed that the fifth lumbar vertebra had been crushed and crowded to the left side in relation to the sacrum. They also showed that the periosteum had been torn off at one side of the spine in two places, and from these two pieces a little new bone had formed in the muscles to the left of the spine. There was no evidence of any injury to or pressure upon any of the nerves.

The man was seen about two years after the accident, and it was considered that he had made a very good recovery, but it was deemed doubtful if he could ever do heavy lifting again without starting up some irritation in the back. His functional recovery otherwise is good. He had had at no time any support to his spine, but undoubtedly would have been more comfortable had he had one.

CASE 3. H. C., man, age 26. On October 7, 1914, while working on the limb of a tree the limb broke and he fell about fifty feet to the ground. He was made unconscious, and remained so for several hours. He was taken to a hospital, where he stayed two weeks in bed. He was then taken home, and stayed in bed two more weeks, when he began to walk about. For the past four months, that is, until February, 1915, he has been wearing a light, untempered, spring back brace. At the time of the accident he also fractured one wrist and some of the carpal bones. He apparently has had no diagnosis made of his condition up to the present. He never had any loss of control of his bladder or rectum, and had no impairment of his motions or sensation. He complains at present, that is, four months after the accident, of severe pain in the back on getting out of bed in the morning. This pain lasts for some time, and returns on walking, becoming finally so severe that he has to lie down. He wears his back brace during the day, but leaves it off at night. Otherwise he appears to be in good condition.

Examination of the back shows that there is a small kyphos involving practically three vertebræ in the dorsolumbar region. This kyphos the patient stated he noticed first about two weeks after the fall,

and that it grew steadily larger for a while, but has not increased any as far as he can tell recently. Bending forward is practically normal, but slightly limited to the sides. Backward bending is limited, and is the only motion which causes pain.

The X-rays (Fig. 2) showed a crushing of the body of the second lumbar vertebra. The crushing was so extreme that without any lateral displacement the body was reduced to about a third of its original thickness. Just why there was a kyphos apparently involving several vertebræ I do not know, unless the deformity of the crushed vertebra allowed the adjacent ones to slump and fall forward in such a way as to cause a backward projection of their spinous processes. Such a crush as this would almost seem to presuppose nerve injury, but he apparently never had the slightest symptoms of any. He still wears a refitted and tempered back brace, and is steadily improving.

This appearance of the kyphos several weeks after the accident is rather an usual condition, and has been noted to occur in other reported cases. The deformity seems to be of rather a gradual onset than an immediate one unless the case is unusually severe.

CASE 4. H. J. A., male, seen February 28, 1913. This patient received his injury in September, 1912, by jumping out of a burning boathouse. He hurt his left side, and has been practically confined to the house since. He walks badly bent over, needing support from two canes. Forward bending of the spine was fair, but side bendings were much restricted. There was no exaggeration of the reflexes and no impairment of sensation. X-rays of the lumbar spine showed a fracture of the right side of the fourth lumbar vertebra, with a spicula of bone about half an inch in length separated from the body of the fourth lumbar.

This man made a practically perfect recovery in about a year's time, and is now free from any symptoms referable to his back. During this year his back was constantly supported by heavy strapping.

CASE 5. J. W. W., middle aged man. This man was riding on his wagon on November 5, 1913, when it was struck by an automobile. He was thrown out, striking on his buttocks. A large contusion appeared over the sacrum, and a hæmatoma formed there. He had much pain in the lower part of the back, radiating down one leg, more on the left than the right. He was in bed three weeks, and has been unable to walk about since on account of pain in back and legs. He never had any paralysis.

Examination on February 9, 1914, showed a very stiff and flat lumbar spine without a kyphos. All motions of the spine were restricted and painful, and muscle spasm was present. The reflexes were normal, and there was no impairment of sensation, except that sensation was less acute on the outer side of the left thigh and calf than on the inside or on the other leg. This limitation of the normal sensation was not sharply marked.

X-rays of the spine (see Fig. 3) showed a compression fracture of the fourth and fifth lumbar vertebræ, with lateral displacement of the fourth on the fifth, so that the spine as a whole above the injury was carried to the left. There is present also a fracture of the transverse process of the fourth lumbar on the left.

This man had a severe and grave injury, which gave him great pain and discomfort, and produced practically complete disability. Under baking, massage, and adequate support to his back he improved considerably, so that in about a year he was able to get about and do some work without great discomfort.

CASE 6. R. P., male, 31, laborer. Examined June 18, 1915. Accident June 24, 1914. This man was struck in the back, while stooping over, by some planks, which slipped off the roof of a house. Following the accident he was in a hospital in bed for eight weeks, during which time he stated he could not move his legs. There has been no impairment of sensation at any time, and he has had no loss of control of his bladder or rectal sphincters. He has not been able to do any work since his injury on account of pain and weakness in the lower back.

Examination of the patient showed that he stood with considerable backward sway. There was a small kyphos in the dorsolumbar region, apparently involving several vertebræ. The flexibility of his back was pretty good, there was no spasm, and practically no tenderness. His reflexes were normal and his general condition was good.

This case had been previously diagnosed as one of Pott's disease of the spine, but as the man denied any previous accidents or injuries to his spine, and stated that he had never had any previous trouble with his back, and as the X-rays showed none of the usual characteristics of tuberculous bone disease of the spine, it seemed to me conclusive that his condition dated from the time of the accident, and that he had suffered a crushing fracture of the spine (see Fig. 4).

In his case the X-rays showed a crushing fracture of the second and possibly the first lumbar vertebra, with a displacement of the bodies to the left and a tilting of the spine to the right. There has been considerable new growth of bone about the edges of the vertebræ, especially between the first and second lumbar, more marked on the concave side than on the convex side of the curve. The kyphos shows as a result of this destructive crushing. There is no injury to the transverse processes which I can make out. The overgrowth of new bone seen between the bodies of the vertebræ is rarely if ever seen in tuberculous processes, and its presence alone

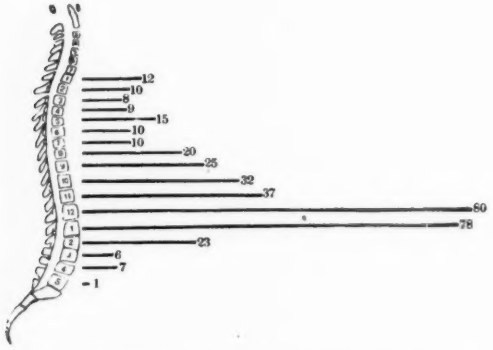

Fig. 6. Diagram (from J. B. Murphy) showing frequency of fracture in region of the spine. (Mènard.)

would indicate that the process was reparative rather than destructive.

The patient should have a back brace of some sort to hold him up properly and prevent the deformity from increasing. With this apparatus properly applied he could undoubtedly do some work, but probably never any hard work requiring lifting or stooping.

Case 7. A. H., age 51, male, carpenter. Accident February 18, 1915. Examined June 15, 1915. This man has always been well up to the day of his accident, February 18, 1915, when he fell from one floor to another, a distance of about twelve feet. He landed on his back. He was taken home, but was not able to go to bed because of pain in the back, which was made much worse when lying down. He stated that he could not move his legs well for about twenty-four hours after the accident, but power to do so soon returned. He had no loss of sensation anywhere, and could control his bladder and rectum at all times. Since the accident, however, he has had severe constipation.

He stayed at home for three weeks, sitting up in a chair all the time, and standing only with help to go to the toilet. At the end of this time, having had no treatment for his back, he was sent to a hospital where he stayed two weeks and where nothing was done for him. He then returned home. All this time he had considerable pain in his back. At one time he was told that he had fluid in his chest which was giving him the pain. However, nothing was done to confirm this.

The pain in his back has stayed about the same as it was at first, and he stated that he has had to change his position frequently in order to be comfortable. He was not able to walk alone for five weeks after the fall, and since then has had to use a cane. The pain he complained of was rather characteristic of girdle pains, and suggested that

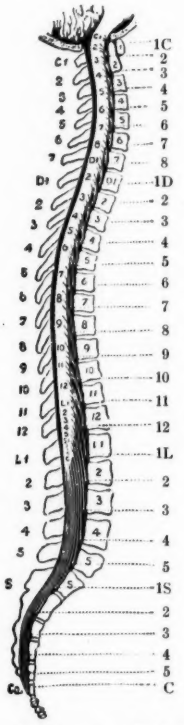

Fig. 7. Diagram showing the relation of the vertebral bodies and spine to the segments of the cord and to the exits of the nerves. (Gowers.)

perhaps some of his nerves had become involved in the injury or callus.

Physical examination showed a large, well developed and nourished man, with a very stiff, irritable and tender back, especially in the region of the first lumbar vertebra. There was no kyphos, and practically no motion in any direction. All attempted motions caused pain and spasm. There was no impairment of sensation in his trunk or legs. His knee jerks were exaggerated, but he had no Babinski. X-rays of his spine (see Fig. 5) showed that he had a crushing fracture of his first lumbar vertebra. This crushing was slightly more marked in extent on the left side than on the right. There was no lateral displacement. There was distinct evidence of new bone formation between the twelfth dorsal and the first lumbar on the left side.

A plaster jacket was applied on June 23, 1915, and gave immediate relief and comfort.

This man evidently had at first some hæmorrhage or œdema about the cauda equina, not great in severity, which impaired temporarily the motor power in his legs. Why such

severe crushes do not cause more severe and permanent injury to the nerves seems strange. One point is worthy of mention, and that is that nothing had ever been done for his back in the way of support, and that he was more comfortable sitting up than lying down. Possibly in the erect position his weight came more on the laminæ and pedicles than on the injured bodies, and he was as a result more comfortable in this position. As a matter of fact none of the cases in this series ever had any special support advised until the diagnosis was made by the X-ray, weeks or months after the original accident, and even then some of them went without any, which speaks well for their endurance and recuperative powers.

LOCATION OF FRACTURES

First lumbar	1
First and second lumbar	1
Second lumbar	1
Second and third lumbar	1
Total	4
Fourth lumbar	1
Fourth and fifth lumbar	1
Fifth lumbar	1
Total	3

This table shows that four of the seven fractures were located in the upper lumbar segment and three in the lower. In such a small series, however, this does not prove anything except that where the injury is secondary to forces applied in flexion the probabilities are that the injury will be located at the point of greatest mobility of the spine, which is at the first lumbar segment (see diagram, Fig. 6).

DIAGNOSIS

The diagnosis of this type of spinal fractures is of the greatest importance, and is not always easy. They may be produced by direct or indirect violence, and may be followed by comparatively no nerve symptoms, or by considerable paralysis, depending on the location of the fracture and its extent. Compression of the cord by fragments of bone or by hæmorrhage in or about it, or by œdema, may occur. In the lumbar region, where the cord stops at the level of the first lumbar, injury to the cauda equinæ may occur, but is not as common as in injuries higher up.

The signs usually present are pain, localized tenderness, kyphos, asymmetry of spinous processes and possibly paraplegia, which soon clear up, rarely involvement of bladder or rectal sphincters. X-rays should be taken as soon as possible (see diagram, Fig. 7).

TREATMENT

As soon as the diagnosis is made the spine should be supported either by a plaster jacket, applied with the spine hyperextended, or the patient should be placed on a Bradford frame with pads under the region of the injury, on either side of the spinous processes, bearing on the transverse processes. Fixation should be continued for at least six months. Operation is rarely indicated unless there is a definite cord injury. Then it should be done without too great delay.

PROGNOSIS

The bony repair is generally good in these lumbar cases, and although there may be a persistent stiffness, the supporting function of the spine is generally good, even in spite of a kyphos, which may tend to increase somewhat. Permanent disability, so far as doing heavy laborious work goes, generally follows such an injury, and as a rule a light back brace is needed for some time or always to give comfort and stability. The prognosis as far as life is concerned is generally excellent. provided no cord injury has occurred.

NOTE.—Since this paper was written the author has had four more cases all involving the lumbar vertebræ. One case only has had cord symptoms, which followed the crushing of three vertebræ, i. e., the twelfth dorsal and the first and second lumbar. She is making a slow and gradual recovery. The others were unaware of their condition until X-rays were taken. The only symptoms were those of a lame, sore, and weak back.

DOUBLE URETHRA WITH OPERATION

Review of the Literature[1]

By DAVID W. MACKENZIE, M.D., New York

THIS case is reported from the Second Genito-Urinary Service of the Bellevue Hospital. I here wish to thank Dr. Keyes, the Chief of the Division, for the case.

The patient, a young man 26 years of age, single, born in the United States, a photographer by occupation, was admitted to our service at Bellevue Hospital on November 17, 1914.

Chief complaint. Sinuses of penis from which urine escapes.

Family history. Unimportant.

Past history. As a child he was troubled with enuresis nocturna, continued until 12 years of age, occasionally since. As far back as he can remember he passed urine from two openings, one in the normal position on glans penis, and one in the frænum. In 1899, after ten days of frequent and painful urination, he had a suprapubic operation in the Buffalo General Hospital for a stone in the bladder. Thinks no stone was found. Was not cystoscoped. The frequent and painful urination continued for a long time after this operation. About three years later, 1902 or 1903, he noticed a small lump about the center of the ventral surface of the penis. It was not painful. Thinks it increased slightly in size. In April, 1912, under local anæsthesia it was cut down upon and a stone about ½ inch in diameter removed from the urethra. The sinus has continued since.

In November, 1912, he went to the New York hospital to have these extra openings in the penis closed. Perineal section was performed, tube inserted and left in position for one week. This opening has also refused to close. Following this operation his frequency was much diminished. Patient states that during erection the distal end of the penis to about one inch behind the glans remains flaccid.

Physical examination on admission. General appearance, a well-developed healthy young man about 5 feet and 10 inches in height, weighing 150 pounds. He has a scar of suprapubic wound on abdomen. Urinary meatus normal in size and position. Sinuses, three in number, one at the frænum, one about 1½ inches from the frænum on ventral surface of the penis, and one in the perineum. Rectal examination showed no abnormalities.

X-ray examination of urinary tract was negative for stone.

Cystoscopic examination revealed a normal bladder with small saccule into which right ureter opens.

Phenolsulphonephthalein output was normal. Exploration with probes and sounds revealed the existence of a urethra apparently normal except for a slight stricture in the bulb admitting a 26 F. sound. Of the three fistulæ the posterior (perineal) one opened into the membranous urethra just behind this stricture. The other two (at frænum and near scrotum) opened into a common passage which readily took a 26 F. sound and entered the urethra in the bulb (in front of the stricture).

Perineal sinus was excised, and its opening at the junction of membranous and prostatic urethra closed. The subjacent canal was split from frænum to bulb. It was found to be lined with normal mucous membrane, and surrounded, with its companion urethra, by a common corpus spongiosum. It was extirpated completely from the bulb forward. This was somewhat difficult on account of its close relation with the upper passage. The wound healed by primary intention, and the patient left the hospital passing all his urine through the normal passage.

In the following brief review of some of the different types of such canals, I will first give the atypical ones, the existence of which has been used as an argument against the double urethra theory, and close with the two main classes of long anterior canals, those that end in a cul-de-sac, and those that enter the normal urethra.

In Luschka's (1) case, a young man who had committed suicide at the age of 19, the penis was found to be normal, but at the boundary of the pubic hair, on the dorsal aspect of the organ an opening 4 mm. in width was seen, leading into a canal of 1.5 cm.[2] At the origin of this canal four openings were discovered, being the excretory orifices of a gland which was actually the median anterior lobe of the prostate displayed on the penis.

In Cruveilhier's (2) case there was in addition to the normal urethra, a narrow canal which originated at the corona glandis and was distinguished by its considerable size corresponding almost to the entire length of the penis, and extending exactly in the middle line from the root of the penis to the

[2] Luschka reports the duct as 1⅗ cm. long but it is misquoted by Lebrun (J. d' Urol., 1912, ii, 403) as 15 mm. long.

[1] Paper read at Seventh Pan-American Congress of Medicine, San Francisco, June 19, 1915.

dorsal aspect of the glans, where it opened above the external urethral orifice in a much narrower round opening. This case came to autopsy where it was shown that the long fistulous tract was derived from the confluence of the two ejaculatory ducts, which, instead of traversing the prostate in the usual manner, passed around to the dorsum of the penis which thus became the bearer of a separate urinary and seminal duct.

Monod (3) reports a case with a very superficial abnormal canal subjacent to the true urethra, parallel with the raphé of the penis and the scrotum. It passed across the perineum and terminated in the rectum, which had no anal opening.

Pribram's (4) patient, 64 years of age, was admitted to the hospital for retention of urine. At a distance of 3.6 cm. behind the corona an opening 9 mm. in diameter was seen in the form of a funnel which was continued into a canal 3.9 cm. in length, situated at the level of the junction of the corpora cavernosa and terminating in a cul-de-sac. There was no communication between the urethra and the abnormal canal.

Examination of the supernumerary urethra showed that its lining was pale and resembled mucous membrane. This patient later came to autopsy, and then it was found that the abnormal canal extended as far as behind the pubic symphysis. About 2 cm. from the vesical orifice of the urethra, the anterior vesical wall presented a funnel-shaped retraction, which led into a narrow canal 2 cm. in length and lined with vesical mucosa, but did not join the other.

Lebrun (5) reports an observation of Marion on a more exaggerated case than the above. This young man, 20 years of age, was admitted to the hospital because of the escape of urine from an abnormal orifice at the root of the penis below the pubic symphysis. This orifice was situated at the pubic end of a long gutter-like furrow extending from the root of the penis to the normal meatus at the tip of the glans. It gave access to a canal which admitted a No. 14 catheter into the bladder. Through the normal urethra only a No. 16 bougie-a-boule could be passed into the bladder, and a stricture was met 10 cm. from the meatus. In the operation the vesical termination of the accessory urethra was exposed and resected. Good repair with complete cure of incontinence.

Histological examination of specimen showed that it resembled in every way the structure of the normal urethra.

Stockmann (6), Rona (7), Himmel (8), Broca (9), and Fronstein (10), also report cases with accessory canals extending in the same general direction to the bladder without connection with the normal urethra.

Lissowskaja (11) reports a case where the abnormal passage extended from the dorsum of the penis across the upper margin of the symphysis to the anterior wall of the bladder. It was extirpated and microscopically presented all the layers of the normal urethra.

Of those ending in a cul-de-sac Jeanbrau's (12) patient is a fair example. He had an accessory urethra 6 cm. in length opening into the balanopreputial groove and terminating near the penoscrotal angle. The supernumerary urethra was extirpated. Histological examination of the specimen showed it to be a real urethra with stratified cylindrical epithelium and a corpus spongiosum.

Perkowsky's (13) case presented a second meatus just behind and above the normal meatus. It admitted a No. 16 catheter for 12 cm. terminating in a cul-de-sac beneath the symphysis. The lining was the same as the normal urethra.

Similar cases ending blindly have been reported by Narchal de Calvi (14), Verneuil (15), Picardat (16), Luxardo (17), Lejars (18), Englisch (19), Ellbogen-Neumann (20), von Dittel (21), Frigerio (22), Englisch (23), Posner-Schwyzer (24), Nobl (25), Martin (26), Le Fort (27), Delbet (28), Stimson (29), DeKeersmæcker (30), Dupot (31), Aievoli (32), Heller (33), Arning (34), Hensel (35), Herman (36), Fantl (37), Worms (38), Walker (39), Ferulano (40), Porosz (41), and Lenehan (42).

Of those communicating with the true urethra Marion's (43) patient, 20 years of age, had a congenital fistula of the glans. A few drops of urine occasionally escaped from it. The normal meatus admitted the exploratory bougie to the bladder. A filiform bougie was

admitted into the supernumerary meatus and easily passed beside the normal urethra into the bulbar region. Injection of methylene blue into this canal returned through the principal urethra. The accessory canal was extirpated. The structure was that of a normal urethra.

Meisels' (44) patient was a boy of 12 years of age with enuresis nocturna and diurna. The tip of the glans presented a normal urethral orifice but the urine escaped in a fine stream from a small orifice below the external urethral opening; only a few drops of urine came from the orifice at the tip of the glans. Endoscopically, it could be shown that there was an orifice more than 8 cm. from the urethral meatus at the upper aspect of the lower urethra; the fluid injected into the upper canal passed through this orifice into the lower canal. Meisels considers this a case of second lower urethra, but it has also been claimed that the lower passage was the true urethra, while the upper passage represented the accessory one. This case resembles very closely the one reported in this paper.

Woods (45), Poisson (46), Dollinger (47), and Djedurin (48), report similar cases where the long accessory canal connects with the normal urethra and through both of which urine passed.

Stinelli (49) reports the histological findings in a case of double penile urethra in a boy of 10 years. The posterior urethra was not available.

A brief discussion of some of the theories follows:

The male urethra originates from two genetically distinct portions of the embryo: the prostatic and membranous portions resulting from the urogenital sinus, while the remaining portion originates at a later period from the folds of the genital ridge or tubercle. The entire female urethra develops from the urogenital sinus. Doubling of the male urethra is rare; in fact some investigators deny the existence of a true double urethra, but the cited cases are sufficiently numerous and authentic to have occasioned numerous theories to explain their nature and origin. There are two important points to be settled according to Lebrun (51): First, is the abnormal canal a urethra or merely some diverticular or canalicular excretory formation? Second, granted it is a true urethra, how is its formation to be explained?

1. Is the abnormal canal a urethra? Luschka (1) explains these canals as displaced excretory ducts of aberrant prostatic lobules. This he found to be true in his own case. It certainly does not apply to all those cases in which there exists a communication of the abnormal duct with the urethra or bladder. Moreover, the autopsy findings in Pribram's (4) case positively show that the explanation does not unconditionally hold good for all cases in which the abnormal passage terminates in a cul-de-sac.

Taruffi (50) suggests that the canal might either be a prolongation of the posterior glands at the dorsal aspect of the urethra, or the urethra having become bifurcated through some mechanical factor, the supernumerary canal would simply represent the upper bifurcation of the urethra ending in a cul-de-sac.

Cruveilhier (2) found in his case which came to autopsy that the canal was derived from the confluence of two ejaculatory ducts, which instead of entering the prostate in the usual manner passed around it to the dorsum of the penis. This is the only case of its kind I find in the literature.

Verneuil (15) attached great importance to the excretion of fluid through the abnormal passage, and accepted the theory of prostatic canals.

Lejars (18) admits this view for some cases, but thinks that it does not explain the diameter of certain canals in view of the slight importance of their excretory function. Moreover, the ectopic prostatic lobule was found only in Luschka's (1) case in support of his theory. The stringy viscid fluid which sometimes comes from the abnormal canal is not necessarily prostatic fluid. It may be from glands analogous to the urethral glands.

Posner and Schwyzer (24) believe that the origin of the abnormal canal is a lacunar duct. This may apply to short canals, but it does not appear probable for canals which occupy the entire length of the penis.

Moreover, the findings on histological ex-

amination of these canals indicate that all the examined cases were true urethras.

2. The explanation as to the formation of these accessory urethras varies likewise according to the different authors. The following are some of the more probable:

Le Fort (27) explains the formation of double urethra as due to an anomaly in the development of the urethral strand. This opinion is shared by Delbet (28) who assumes that the epithelial strand destined to become the urethra proliferates too far upward, and becomes longitudinally divided in its middle so that there are two portions of the epithelial strand, one above the other, which promptly becomes separated by the interposition of mesodermic tissue. These two completely separated strands are supposed to give rise to the two urethras, the upper one of which may undergo partial atrophy terminating in a cul-de-sac. Lebrun (51) is inclined to accept the theory of Le Fort (27) and Delbet (28), and he attributes the formation of double urethras to an anomaly in position and dimension of the primitive epithelial strand destined to become the urethra.

When this epithelial strand is especially well developed and slightly deviated toward the dorsal aspect of the penis as in epispadias, it will become longitudinally divided by the fusion of the two genital folds at the level of their upper margins. In consequences of this fusion the urethral strand is divided into a principal lower portion which gives rise to the normal urethra and an upper portion which forms the supernumerary urethra.

Kaufmann (52) assumes the occurrence of fistulous perforation of the genital ridge in consequence of urinary retention in the posterior urethra, at the time when the anterior urethra is not yet developed. When the anterior urethra begins to functionate, a septum is found between the fistula and the urethra; this seems incorrect because the fistula would not have the same structure of its walls as the urethra.

Meisels (44) interprets the origin of the two parallel urethras in such a way that the two separate beginnings of the urethra diverge in the direction of their growth.

Löw (53) suggests that the urethra originates through the destruction of part of the stratified epithelium which fills the mesodermal genital groove. It is possible for two ducts instead of one to originate within this solid epithelial plug.

Rona (7) regards all accessory ducts of the penis as developmental anomalies which originate through constricted longitudinal folds of the urethra.

Klebs (54) considers the second urethra as an arrest of development of the vesicopenile cleft, a healed epispadias. But although the epispadias accounts for the opening of the urethra on the dorsum of the penis it does not explain the formation of two canals.

By Lejars (18) this anomaly is classified under the heading of epispadias. In his opinion the cavernous buds are originally double, epispadias being a failure of these buds to unite. Furthermore, in the apposition of the two cavernous buds, a non-united strand is left in the middle constituting the doubled urethra. This theory is very simple and would be highly satisfactory if the penile bud was originally double, but according to the investigations of Rathké and Tourneux (56) it is simple, which discredits the above theory.

Meyer (55) raises an objection to Lejars' theory and claims that the corpora cavernosa are not concerned in the transformation of the urethral groove into the urethral tube, the urethra being surrounded only by its own corpus spongiosum. Furthermore, the genital ridge is single from the start so that there can be no junction or adhesion. Meyer explains the genesis of double urethra as follows: The upper wall of the urethra originates from the ventral wall of the cloaca. If the latter is placed abnormally far in the ventral direction, it enters into relation with the ectoderm in a certain area. This is followed by total or partial mesenchymal constriction and separation of the abnormally dorsally situated epithelia. Being provided with the formative material for the urethra, these epithelia then grow out with the penis into long channels. According as the constriction is total or partial they terminate blindly, or they communicate with the blad-

der and with the skin on the dorsal aspect of the penis, or at the glans. The lower wall of the urethra becomes constricted off relatively late from the external skin at a time when the mesenchymal tissue is further differentiated, passing behind forward, so that the urethral segments of the glans is detached from the skin, and closed a few weeks later than the posterior segments of the penile urethra. Hence there can be no canal in the lower wall which is composed of the primarily canalized posterior urethral segments derived from the urogenital sinus as well as of the urethral portion in the penis which is constricted off at a much later date.

The following plausible explanation is offered by Meyer (53) for the formation of accessory canals at the lower side of the penis. The epithelial ridge from which the urethra is formed is surrounded by connective tissue in such a way that the lower branch of the ridge (which is cruciform in cross section), becoming constricted off by the approximating lips of the connective tissue, is crowded against the surface of the lower side and detached. When this constriction fails to occur, the lower branch nevertheless is not utilized for the formation of the urethra but it is secondarily constricted off and forms a submucous canal. In case the primary constriction takes place but not the detachment, the constricted epithelial strand becomes promptly surrounded by ectodermal tissue and a subcutaneous canal is formed.

CONCLUSIONS

The occurrence of more or less complete duplication of the male urethra, involving the canal from the bulb to the meatus, cannot be doubted, as a large number of well authenticated instances of several degrees of the anomaly have been recorded. Accessory canals have been described of about equal size to the normal urethra and freely communicating with it in the bulb as in Meisels' and the author's case.

In other observations one passage was smaller than its fellow with which it connected or ended in a cul-de-sac. Perfectly authentic cases of accessory urethras extending to the bladder have also been reported.

The development of the anterior and posterior male urethra from distinct embryonic structures renders a complete congenital duplication of these parts extremely rare. The pathogenesis of all urethral duplications meets with difficulties and many explanations have been suggested, the most probable theory referring the formation of a double urethra to anomalies of the epithelial urethral strand in the embryo.

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DEPARTMENT OF TECHNIQUE

REPORT OF A CASE OF EXSTROPHY OF THE BLADDER OPERATED ON NEARLY THIRTY YEARS AGO[1]

With Subsequent History

By RANDOLPH WINSLOW, M.D, F.A.C.S., Baltimore

IN May 1886 Georgie T., a white female child aged six years, was brought to the Hospital of the Good Samaritan, Baltimore, by Doctor Samuel T. Earle, who placed her under my care.

She was a small but well nourished and very intelligent child, who was in a deplorable condition. In addition to a large congenital prolapse of the rectum, she was suffering from exstrophy of the bladder, the opening being 2½ by 2 inches in diameter and trefoil in shape. The exposed mucous membrane was red, vascular, and bleeding; covered with mucus, ammoniacal and offensive in odor. There was constant dribbling of urine and her skin and clothing were always wet. The pelvic bones were widely separated and her gait was awkward and waddling. No hernia was present in either groin. There was no urethra but only a shallow groove where the urethra should have been. The labia were separated from each other and the clitoris was not seen. The vagina was apparently present, but nothing was determined in regard to the uterus and ovaries. The umbilicus was absent. Her appetitie was good. Dr. Earle operated on the prolapsed rectum with the thermocautery, and subsequently he narrowed the anal orifice, eventually curing her of this malady.

On June 1, 1886, I performed a modified Wood's plastic operation for the relief of the exstrophy. An umbilical flap was turned down with its raw surface outward and two small flaps were turned up from the vulva and sutured to the lower edge of the umbilical flap, leaving a small opening at the lower margin for the escape of urine. Two lateral abdominal flaps of considerable size were raised and twisted with their raw surfaces inward so as to cover the other flaps, and their margins were sutured in the middle line. Catgut sutures were used for holding the raw surfaces together and sublimated silk for the external wounds. A large portion of the extensive raw surface of the abdomen was closed with sutures, leaving only a narrow uncovered strip to be healed by granulation. The umbilical flap consisted of very thin skin and but little subcutaneous tissue, while the lateral flaps were pretty thick and vascular. The surfaces were dusted with iodoform and covered with gauze and absorbent cotton. The patient was considerably shocked but rallied easily and she suffered little or no pain subsequently. The urine escaped freely from the small opening between the

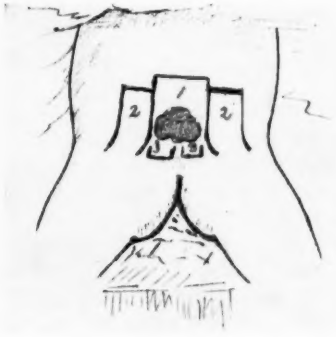

Fig. 1.

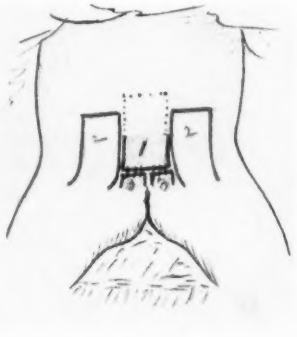

Fig. 2.

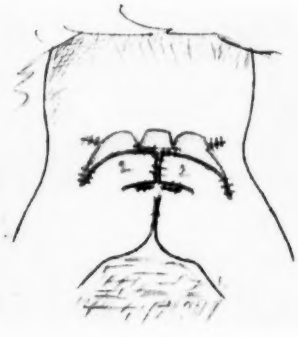

Fig. 3.

Fig. 1. Exstrophy of the bladder. Flaps outlined. *1*, Umbilical flap, *2*, lateral flaps, *3*, labial flaps.

Fig. 2. *1*, Umbilical flap reversed and united to reversed labial flaps *3*, *3*. The shaded portion indicates the raw surfaces of these flaps.

Fig. 3. *2*, *2*, Lateral flaps placed over the other flaps and united in the middle line. All the portions sutured. Shaded portion indicates the extent of denuded surface which could not be sutured and which healed by granulation in a few weeks.

[1] Read before the Southern Surgical and Gynecological Association, Cincinnati, December 13–15, 1915.

Fig. 4. Result after healing.

flaps. For several days her temperature remained nearly normal but on the third day febrile symptoms began to set in and an examination showed the wound to be in good condition, but an erysipelas ambulans was discovered traveling upward from the buttocks toward the flaps. On the fifth day the erysipelas reached the flaps but was fortunately very superficial in character and did not cause much disaster. A strip of the left flap about one-half to three-quarters of an inch in width along its middle and lower edges sloughed and left a gap to be healed by granulation. This gap was materially lessened by the use of deep silver wire sutures shotted on lead plates. Healing of all wound surfaces was accomplished in about six weeks.

The condition of the child was vastly improved but there was, of course, no continence of urine. It was possible, however, to keep her drier, more comfortable, and less offensive to her neighbors. This was about as good a result as was attainable at that time; indeed, any other operation would have been well-nigh impossible on account of the marked prolapse of the rectum that was present. At the present day I think some other procedure should be employed in cases of exstrophy of the bladder, and I personally favor the implantation of the ureters with the trigone of the bladder into the sigmoid or rectum, the extirpation of the remainder of the bladder, and the closure of the gap in the abdominal wall with sutures.

I have not thought this case worthy of publication on account of the method of procedure employed or by reason of the success of the operation, but because of her subsequent history, of which I have only recently become cognizant. After remaining six months in the Samaritan Hospital, she was removed to Bay View Asylum, where

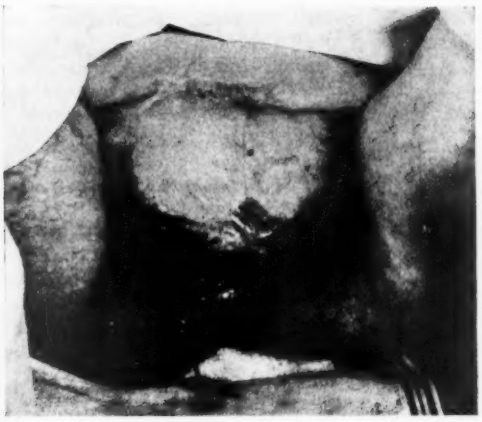

Fig. 5. Condition of parts in December, 1915.

I subsequently saw her upon several occasions; the last time probably in 1890, when she was ten years of age.

In Howard A. Kelly's *Operative Gynecology*.* I find the following account evidently referring to the same girl:

> In a case of a girl of 15 (G. T., No. 3,869, October 14, 1895) the pubic bones were separated four centimeters with a thin, sharp-edged fibrous band between them; above this there had been a total defect of the anterior bladder wall, covered by inverted flaps of skin taken from the sides and so adapted as to leave only a small orifice open just above the fibrous band, through which the urine escaped. By rectal examination, I found an infantile uterus and ovaries, and on making a cystoscopic examination between the flaps two little oval openings representing a double hymen were discovered on the posterior wall of the bladder; a sound passed through them led up to the cervix uteri.

I lost sight of the girl and did not know what had become of her until January, 1914, when I received a letter from Dr. Charles B. Reynolds of Philadelphia in regard to her. She had been married some years and had been delivered of a child by Dr. Reynolds a short time previous to the date of his letter to me. This was her third child; the first having been born in November, 1901, following an instrumental delivery. This child was born alive. The second child was delivered by podalic version in 1903 and was born dead. The mother was badly lacerated and had her injuries repaired at the Cambridge Maryland Hospital.

During the third labor in December, 1913, Dr. Reynolds saw her in consultation and finding her condition serious had her removed to the

* 1898, vol. i, p. 319.

Medico-Chirurgical Hospital, where she was etherized and delivered of a large dead baby that presented by the breech. While she was in the hospital, a skiagraph was taken of her pelvis which showed an absence of the symphysis pubis and a gap of 3 inches between the pubic bones. In commenting on her condition, Dr. Reynolds says, "She appears to be a strong and an otherwise well developed woman and quite intelligent." She was sensitive about her malformation and disinclined to allow any examination of her genitalia. In January, 1915, she was delivered by Dr. Reynolds of a fourth child, a girl weighing 9 pounds, which was born alive. This was a shoulder presentation which was delivered by podalic version.

Exstrophy occurs much less frequently in females than in males, but the condition is none the less deplorable. In many cases both the external and internal organs of generation are malformed or undeveloped and the woman, if she lives to adult life, is usually incapable of bearing children.

The first fact, therefore, that makes this case noteworthy is that she has come to term four times within a few years. Secondly, the labors were all dystociæ; one child having been delivered with forceps and the others either by podalic version or by breech extraction.

When we consider the absence of the symphisis pubis and the wide separation of the pelvic girdle, the diastasis of the recti muscles and the weak condition of the lower abdominal wall, it is not remarkable that she was unable to give birth to a child in the normal manner and that the deliveries were all abnormal.

I find it stated by Da Costa that only 30 per cent of the victims of this malformation live beyond the twentieth year; it is, therefore, very gratifying to me to know that this woman, upon whom I operated 29½ years ago, is still alive and in reasonably good health.

In a letter received from Dr. Reynolds on December 10, 1915, he says: "The woman is well nourished, intelligent, and is enjoying good health, though she has prolapsus uteri. She is able to perform her regular household duties satisfactorily."

IMPLANTATION OF THE TRIGONUM INTO THE SEGREGATED LOWER END OF THE ILEUM[1]

By VILRAY P. BLAIR, A.M., M.D., F.A.C.S., St. Louis

THIS single case is reported partly because the operation proved a failure, in that the patient died, and partly because it was designed with the hope of overcoming two of the obstacles that have been encountered in the attempt to successfully form a visceral receptacle for the urine in exstrophy of the bladder. The difficulties lie in preserving the blood supply to the trigonum and in protecting the kidneys. In regard to the former it succeeded but presumably failed in the latter.

The patient was a girl six years old. At examination, the labia majora were found well formed posteriorly and separated widely anteriorly. There were two small "dog ears" on the anterior median part of the labia majora which somewhat resembled, and were taken for the labia minora. Between the posterior parts of the labia majora was a transverse slit three millimeters wide with a somewhat fluted mucous lining. This was taken for the external opening of the vagina. The umbilicus was low. Below the umbilicus the recti muscles seemed to separate leaving a hernial protrusion which extended from the umbilicus to the pubis and when the child cried, stood up about five centimeters. Most of this protrusion was covered with skin but its extreme lower part was red and apparently covered by mucous membrane; this patch was about two centimeters across. In this there were two small vertical slit openings, one millimeter long, from which urine came in jets alternately. The left slit was at a higher level than the right. The diagnosis was exstrophy of the urinary bladder, complete absence of all bladder wall except the trigonum, deformity of the external genitals and absence of the lower end of the vagina.

The operation was done in two steps. The first consisted in dividing the ileum ten inches from the cæcum, the cut end of the distal segment being closed by suture; the proximal part being implanted into the ascending colon. The idea was to use the ten-inch segment of the ileum for the urinary receptacle in the hope that the ileocæcal valve would protect the ureters from ascending infection. At the second operation this segment was found to be free from fæces. There was some discussion at the time as to the propriety of turning the urine into the right half, the absorbing part of the colon, but there seemed to be no evil result from this.

The second stage of the operation was done three months later, when the trigone was freed from the abdominal wall and left attached to a triangular flap of peritoneum attached below and containing a ureter at each border. The blood supply was so free that many ligatures had to be applied after the trigone was freely

[1] Read before The Southern Surgical and Gynecological Association, Cincinnati, December 13–15, 1915

mobilized. No difficulty was encountered in making a lateral implantation into the lower segment of the ileum. It was also possible to cover the site of implantation and the raw surface of the peritoneal flap, carrying the ureters, with parietal peritoneum even down to the triangular ligament which was developed into a thick ligamentous band that replaced the symphisis pubis. There was no subsequent urinary leakage.

A third operation; viz., the strengthening of the wall at the site of the hernia by the transplantation of fascia lata had been contemplated for a later date.

The child apparently did well for a year, holding its urine all night and during the day passing it about each two hours with plenty of warning. They lived at a distance and only one specimen of urine was obtained, which was six months after the implantation. Examination showed a specific gravity of 1,016, alkaline, some albumin, no sugar and no casts. The child at this time was in excellent health. About one year after the second operation the child became sick, lost weight and had a waxy color. When seen two months later she looked bad and complained of a great deal of cramping pain in the lower abdomen which suggested that a urinary calculi might have formed in the new urinary bladder. An X-ray picture could not be made without an anæsthetic and a request to come to the hospital was deferred. The blood at this time showed a slight leukocytosis and 77 per cent polymorphonuclear cells. About one month later the child died; no autopsy was performed but the attending physician reported the death due to uræmia.

A SIMPLE MODIFICATION OF AN OLD VAGINAL SPECULUM

By HERBERT W. HEWITT, M.D., F.A.C.S., Detroit

THE right-hand figure in Figs. 1 and 2 shows a vaginal speculum, weight, and chain, which has for years been sold under the name of Metcalf vaginal speculum. I have used this speculum in my work for ten or more years. Its main disadvantage is that the chain and weight are easily disconnected from the speculum. This may be prevented by substituting a simple harness snap for the long chain and closing the shepherd's crook wire stem of the weight, as shown in the left-hand figure in Figs. 1 and 2.

Another improvement has been made by the instrument maker as shown in Fig. 3, in the right hand figure. The new one is made much lighter and has a trough for blood and irrigating fluids. This simple modification can be made in a very few minutes and makes the most satisfactory vaginal speculum I have ever used

Fig. 1.

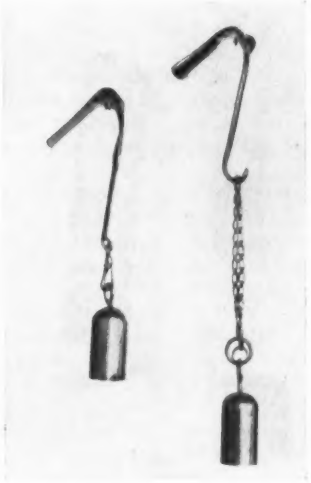

Fig. 2.

Fig. 3.

NITROUS-OXIDE-OXYGEN ANALGESIA IN LABOR[1]

By W. C. DANFORTH, B.S., M.D., F.A.C.S., Evanston, Illinois
Attending Surgeon, Evanston Hospital
From the Obstetrical Building of the Evanston Hospital

IMMEDIATELY after the appearance of the papers of Drs. Webster and Lynch in March, 1915, describing their experience with nitrous-oxide analgesia in obstetrics, the use of this method was begun in the obstetrical department of the Evanston Hospital. Previous to that time nitrous oxide had been used in the hospital for minor operations, painful examinations, and for a considerable number of major surgical procedures, including cæsarean section. All general anæsthetics had been begun by the administration of nitrous oxide for a period of several years. Since beginning its use in labor, it has been used in 133 cases. Of these, 33 have received it for periods of two hours or more. The longest time it has been given to any patient has been seven hours. Of these 33 cases, 7 have taken it for three hours, 1 for five hours, 1 for six hours, and 1 for seven hours. The remainder of the 33 cases have received it for periods varying from two to three hours.

Careful records have been kept of the cases in which gas has been used, a special blank being prepared for the purpose upon which has been noted the character of the case, the length of time the gas was given, the effect upon the fœtal heart, the effect upon the maternal heart, the effect upon the pain, the character of the analgesia, and the condition of the babe at birth. We are, therefore, in a position to know precisely what our results have been, and to compare them with the results obtained by other means of relieving pain.

We have so far been satisfied with results which have been obtained. We do not find that gas lessens the force of the uterine contractions, provided that it be given only to the degree of analgesia. On the contrary, in some cases, the uterine contractions seem to be better after the gas has begun than they were before. After the patient has learned how to breathe the gas and obtains relief from pain, she will work much more satisfactorily than she did before. As she is at no time unconscious, she is amenable to suggestion and will, as a rule, follow directions accurately. Patients are much more easily managed under a properly given gas analgesia than when the mentality is clouded by the effect of ether or chloroform. The gas can be given over a much longer time than ether, and as our experience has grown, we have been inclined to begin the administration of the gas earlier than we did at first. We have observed no harmful effect upon the fœtal heart. Administration for hours in long labors has been accompanied by no change in the heart tones which we have been able to ascribe to the effect of the nitrous oxide. The maternal pulse has in no case undergone any change that seemed chargeable to the gas. We have had no asphyxiated babies. The condition of the child at birth has in every case been good. In several cases the child has been observed to cry before birth was complete in at least two cases as the shoulders came over the perineum. The placental stage has seemed to be shortened, probably because the contractility of the uterus has not been diminished by the anæsthetic.

In no case has hæmorrhage occurred. In one case in which the gas was continued for several hours the uterus was packed. This woman has a uterine fibroid of considerable size and had had a long and tedious labor, terminated instrumentally, and was not bleeding dangerously at the time, the uterus being packed for prophylaxis.

The technique has been in all essentials that described in the papers of Lynch and Heaney. It has been developed as a result of our own experience which has led us to about the same point so far as the mode of administrations is concerned as it has them. We had the advantage of the description of the technique given by Lynch in his paper.

Administration of gas is begun at the end of the first stage or earlier if the pains are severe enough to cause real suffering. There seems to be no objection to beginning it at any time during the latter half of the second stage, if the attendant desires. A small dental nose piece is used. The hand upon the fundus of the uterus detects the beginning contraction, at which time the inhaler is placed over the nose and the gas turned on. The patient is told to take deep, quick breaths, opening the mouth as soon as the pain of the contraction is greatly lessened or disappears. We have a few times tried the suggestion of Lynch; namely, that the patient be given a light to watch and instructed to open the mouth if the light seems to waver. Usually this is not

[1] Read before the Chicago Gynecological Society, November 19, 1915. (For discussion see p. 376.)

necessary, as a patient of intelligence soon learns to open the mouth and so keep herself from passing from the stage of analgesia into that of anæsthesia. From four to eight breaths of gas are necessary to produce analgesia; the amount necessary varying with the individual patient.

We have experimented with various modes of administering gas. For a number of cases we have given nitrous oxide alone for the first two or three breaths, and then added from five to ten per cent of oxygen. In a considerably larger number we have used the gas alone, only adding oxygen if a trace of cyanosis appeared. The cases in which nitrous oxide alone has been used, with the addition of oxygen only for cyanosis, or perhaps at the end of the pain for the purpose of rapidly freshening up the patient, have seemed to us to be the most satisfactory. After the stage of analgesia is reached, which is usually attained during the first half of the pain, the remainder of the pain will be borne without the administration of gas and without the feeling of pain. In some cases we have had to continue the administration of gas throughout the greater part or all of the pain. This process is repeated with each pain over as long a time as may be necessary. As the head passes over the perineum, we have usually changed the small nose piece for a larger mask which covers the mouth and nose in order that a deeper degree of anæsthesia may be given.

Good results are to be attained only by careful observation of the patient during the administration of the gas. If she be permitted to pass too deeply under the influence of the gas, the effect is not as good as if she be maintained in the zone of analgesia. If analgesia be permitted to pass into anæsthesia, the ability of the patient to respond to suggestion is lost, and she also seems to be more susceptible to pain. Even slight cyanosis is to be avoided and is not necessary. If the woman gets a little too far under the influence of the gas, a whiff or two of oxygen at the conclusion of the pain will rapidly correct any tendency to stupor. If she complains of dizziness or is slightly cyanotic, or the eyes tend to fall shut, the amount of gas must be decreased.

In a number of cases, low forceps has been done, although usually ether is used if instrumental interference is needed. Episiotomy and perineorraphy have been frequently done. Usually for these procedures and always for forceps, the anæsthesia has been deepened to the surgical degree.

While one of the greatest advantages of gas analgesia is that it may be given over a considerable period of time, some of the patients who have evinced marked satisfaction have been multiparæ, who have taken the gas for periods of less than two hours in rapid labors. In many instances these have been patients who in former labors had received but little relief from pain either because ether had been withheld or had been inefficiently given. These women are given relief from the pain of the second stage without increasing the length of labor at all. In primiparæ in whom the first stage is long, by the use of a hypodermic of morphine early in the first stage, and the use of gas beginning toward the end of the first stage and continuing through the second stage, a high degree of relief from pain may be attained.

All patients who have taken the gas two hours or more, and a considerable number of the others, were questioned on the third or fourth day as to the amount of relief from pain which they experienced. Many of them said that they were fully conscious of the contractions, but did not feel pain. Almost all of the remainder stated that the pains were very greatly relieved. Only two were of the opinion that the pain was relieved but little. A large number of these patients have said that they were fully conscious of the contractions but did not feel pain. They would clearly remember working and bearing down at direction and would repeat remarks which they had overheard in the labor room, but would not remember pain or would have but a slight remembrance of pain.

So far as our experience has gone, we have been unable to see any danger in nitrous-oxide analgesia. Nitrous oxide has long been known as the safest anæsthetic when carefully given. It causes no visceral lesions either of the mother or the fœtus. Its volatility is so great that the tissues are free of it almost immediately after administration has been stopped after each pain. Its great advantage as to safety for the infant will be at once apparent to any one who has read the report of Graham upon the results of chloroform anæsthesia on the young of pregnant animals. While the tissue damage caused by ether is by no means as great as that caused by chloroform, the advantage still rests strongly with nitrous-oxide. The safety which statistics have accorded to nitrous oxide has recently been again proved by the work of Woodyatt.

The machine used is a standard one made by a well-known firm and fitted with regulators to control the rapidity of the flow of gases from the cylinders to the mask. The expense of administration is well within the reach of families of moderate means. One who has had experience

in administering analgesia will attain good results with a surprisingly small amount of gas. A machine fitted with regulators is much more economical of gas than one without and renders the administration distinctly easier. A number of times one small tank of nitrous-oxide has sufficed for three hours of analgesia. It is perfectly possible to use the method in a private house if a nurse or attendant accustomed to its use is present and the proper apparatus is available. The same firm which manufactures the apparatus which has been used in this series of cases is at present perfecting a small portable apparatus which fits within a case of a size to be easily carried.

The advantages which have seemed to be most striking are: first, the high degree of safety; second, the fact that relief of pain may be secured without impeding the course of labor; third, that its use may be prolonged for hours, if necessary; and lastly, that the administration of gas analgesia is sufficiently simple that any practitioner willing to devote a little attention to it may readily learn its administration.

A PELVIMETER FOR MEASURING THE PELVIC OUTLET

By F. L. ADAIR, M.D., Minneapolis, Minnesota
Associate Professor of Obstetrics, University of Minnesota

THE importance of recognizing abnormal pelvic outlets is being constantly brought to the attention of obstetricians. Methods and instruments of various kinds have been described for the purpose of determining the size of the outlet of the parturient canal. The earliest and greatest attention was given to the distance between the tubera ischii; more recently attention has been called to the measurement of the anterior and posterior sagittal diameters of the outlet. The importance of the angle of the pubic arch is recognized; but so far little, if any, attention has been given to the measurement of this angle. It is for this purpose that the instrument to be described has been devised.

The instrument, Fig. 1, has three scales, one (*A*) for measuring the distance from the pubic arch to the tubera ischii, another (*B*) for measuring the distance between the tubera, and a third (*C*) for estimating the angle. The instrument is quite easily adjusted and the scales can be read at a glance. Asymmetry of the outlet may be measured with this instrument. The importance of the angle in relation to the transverse diameter of the outlet is shown by the diagram: In Fig. 2, *A–C* = 9.5 cm. and *D–F* = 8 cm.

It is apparent that a spheroidal body such as the infant's head which had a biparietal diameter of less than 9.5 could pass between the tubera. It would, however, require more room in the anteroposterior diameter with a pubic angle of 90° *A–G–C* than it would with an angle of 60° *A–B–C*. In this instance a narrow angle

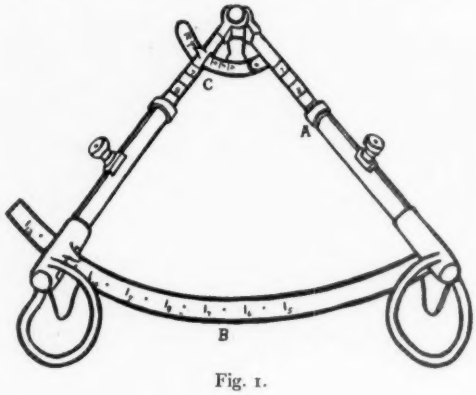

Fig. 1.

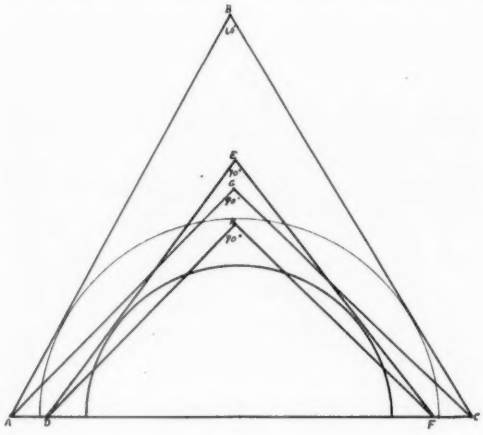

Fig. 2.

would be more favorable with a base of the same length. The same would be true with an interischial diameter of 8 cm. *D–F*. The angle 70° *D–E–F* might be more favorable than the more obtuse angle 90° *D–E–F*. It is also apparent from a comparison of the equal angles *A–G–F* and *D–H–F* with bases of unequal length that a larger object could pass through the former.

The circles indicate that it is not sufficient to know the distance between the tubera and the length of the anterior and posterior sagittal diameters but we should also consider the relationship of these measurements to the pubic angle bearing in mind that a narrow angle may be more favorable than a broader one.

It would seem that the distance from the line between the points where the head impinges on the sides of the angle to the tip of the sacrum would be of more value than the so-called posterior sagittal diameter. If 8 cm. is assumed to be the proper minimum distance, then the posterior median diameter corresponding to the posterior sagittal should be measured from the center of a line extending between points on the legs of the triangle, which are 8 cm. apart. This line might be anterior to the transverse diameter of the outlet. In other words the points where the head impinges on the legs of the triangle may be more important than the distance between the ischial tuberosities.

The narrow angle is unfavorable only in so far as it indicates a short transverse diameter of the outlet. As yet my measurements are too few in number to be of any value for statistics.

DESCRIPTION OF A SELF-RETAINING BLADDER RETRACTOR

By J. C. MASSON, M.D., Rochester, Minnesota
From the Mayo Clinic

In all surgical operations on the bladder, good exposure is a very important factor and to accomplish this a great many instruments have been devised. In our experience the lateral retractors of the Walker type have been the most practical; but they have the objection of requiring extra assistants. To avoid this, we have applied the same type of blades to a self-retaining retractor. When the instrument is closed, the upper parts of the blades dovetail into one another to help in inserting. They are attached to the rest of the retractor by pivot-joints, allowing free movement, which is a great convenience as the body of the retractor can be turned to where it is least in the way of the operator. By spreading the retractor and holding the fundus well back with a long tongue-depressor in the hand of an assistant, the operator can see the entire interior of the bladder. The retractor is especially useful for exposure in removing neoplasms of the bladder and in suturing the capsule following the removal of adenomatous hypertrophy of the prostate (Figs. 1 and 2).

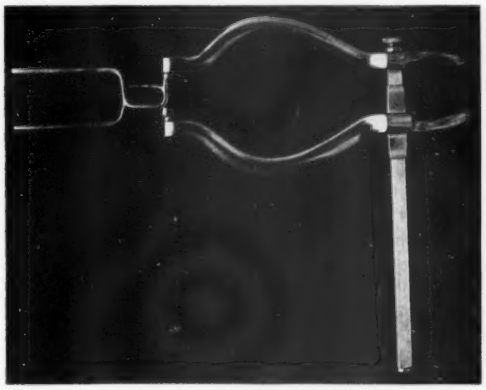

Fig. 1. Instrument ready to insert.

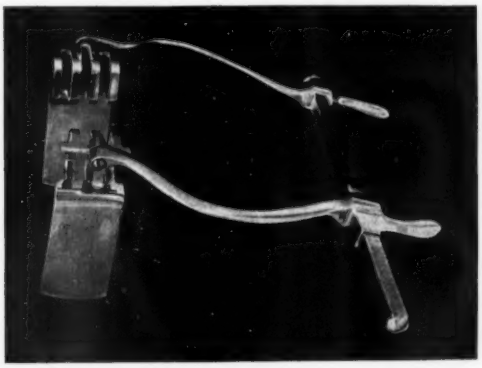

Fig. 2. Instrument in place.

THE LOCAL APPLICATION OF RADIUM SUPPLEMENTED BY ROENTGEN THERAPY [1]

By RUSSELL H. BOGGS, M.D., Pittsburgh
Roentgenologist, Allegheny General Hospital; Dermatologist and Roentgenologist, Pittsburgh, Columbia, and St. Francis Hospitals

THE therapeutic action of a local application of radium is due to rays emitted, which penetrate the tissues and therein produce certain changes. The character and extent of changes depend upon the quality and quantity of the radiation. Weak radiation may stimulate the cells, while larger doses inhibit cellular functions and finally cause death. Every call is susceptible to this stimulation or inhibition, but the effect varies in degree with the cells of different tissues as well as with the dosage. Thus the glandular epithelium of the testicle, ovary, breast, liver, spleen, the thymus, thyroid and lymphatic glands is more susceptible than the stroma of the same organs.

Investigations have shown that the rays given off both by the radium and the X-ray tube act primarily on the nuclei of the cells and inhibit their power of proliferation before the function of the cell is impaired. Embryonic cells and those which are undergoing active proliferation are the most susceptible. It has been shown that malignant growths are retarded by radiation and become less malignant, although they may not have diminished in size or disappeared. By further increasing the quantity of radiation, the injury becomes more pronounced and the cells are completely destroyed, the rays acting differently on the various type of cells; destroying one kind of tissue and leaving the other adjacent tissues intact or so slightly injured that they will completely recover.

The therapeutic action of radium on a new-growth consists not only in the destruction of the tumor-cells but also in the change produced in the blood-vessels. The endothelial cells of the intima degenerate, the lumen of the vessels retract and finally are obliterated, and consequently the tumor-cells cannot obtain the nourishment needed for their maintenance of life and for their proliferation.

When a tube of radium is brought in contact with a growth or is inserted into it, a certain dosage will inhibit the proliferation and finally cause necrosis of the cells nearest it, while further away from the tube the same kind of cells will be stimulated. This observation has been made by many and is a settled fact. The statements made as to the depths in which the cells are affected vary between two and five centimeters, two and one-half being that which is generally accepted. So radium has its limitations in the treatment of malignancy and must be supplemented by something which will destroy the metastasis in the deep lymphatic glands which cannot be reached effectively by radium rays.

The quantity of rays reaching tissues adjacent to the radium tube diminishes inversely as the square of the distance. The more susceptible a cell is, the smaller the dose necessary for its destruction and consequently the greater the distance at which it may be influenced. Since the effect of the rays decreases as the square of the distance from the radium, it necessarily follows that tissues acted upon must be as close as possible. Whenever it can be arranged, the abnormal tissue should be brought in contact with the radium container, while the normal tissue should be as far as possible from it. When large growths have been treated, it has been determined by biopsy that the periphery of the growth is stimulated by the attenuated rays that are able to reach through, while the malignant cells in the tissues in contact with the radium are destroyed. Many have long realized — since light decreases inversely with the square of the distance — that, if the source of radiation is placed in contact with the skin of the patient, the dose is many times stronger on the surface than at a depth where the disease must be destroyed. The greater the distance the source of radiation is placed from the surface of the body, the more nearly the tissue at a depth will be rayed homogeneously. With an X-ray tube placed twenty inches from the surface, a growth situated four inches below the surface will receive almost the same amount of radiation as the skin less the amount cut off by absorption of the four inches of tissue. Some radium workers who have large quantities of radium have placed it at a distance, thereby reaching a more nearly homogeneous radiation than by bringing it in contact with the surface of the body, but until they can obtain many grams of radium this is not any more practical than attempting to treat cancer of the uterus with five milligrams of radium locally and expect results.

[1] Read before the American Roentgen Ray Society. Atlantic City, N. J., September, 24, 1915.

As it greatly increases the time of exposure to increase the distance of the source of energy, a roentgen tube should be placed as close as possible without impairing results at the desired depth. The shortest distance can be determined only by the amount of radium radiation given locally and by the amount of cross-firing. Of course the loss by absorption must be supplemented by cross-firing.

The general opinion at present is that all malignant tumors are in their early stages merely local, so that a complete cure may be obtained by early and complete removal. Unfortunately no clinician is able to state when such is the case; the facts are quite otherwise. Generalization and recurrence in the cicatrix and the glands frequently follows even when the tumor has been completely excised in its early stage. So frequently is this the case that we are bound to conclude that the disease is regional and not entirely local from the beginning, even before the neoplasm is recognizable by the naked eye, because the whole of the lymphatic circulation as well as the glands are already infected.

This is shown by the fact that recurrence is frequently seen in the cicatrix of an incision at a considerable distance from the original lesion. Leduc states: "For some considerable time after this regional infection by malignant disease, the lymphatic glands are able to defend the organism against the general invasion of the disease. The glands here play a double rôle: they are both fortress and garrison, arresting the invasion, and defending the organism against the entrance of the pathological germs."

If his deductions are correct the surgical removal of the lymphatic glands, even in a very early operation for cancer, is to be depreciated, unless every part of the garrison, i.e., the lymphatic glands, which are holding metastatic cancer-cells, is removed at the time of operation. Otherwise it removes the only barrier to the invasion and the only defense of the organism, thus hastening the end. We are sure that the surgeons would not operate on a great many cases that they do if the visceral generalization had been as easily recognizable as the local recurrence in the glands or scar, or if they had had these cases treated most thoroughly and radically by modern radiation. An incomplete surgical removal neither prolongs life, retards the progress, nor affords palliation, but rather hastens the progress. This is not true of radium applied locally because the lymphatics are never opened. However, it has the disadvantage of not giving off rays which will act at sufficient distance from the radium tube to destroy the cancerous cells in all the adjacent lymphatics.

Experience of the past two years has shown that we cannot treat successfully with radium at a greater distance than two or a maximum of three centimeters. It has been universally accepted that cancerous growths can be promptly and also apparently permanently cured at this depth from the radium tube. However, if the disease is advanced and there is infiltration of the growth into adjacent lymphatics, the cure is only apparent. The local growth may disappear, but if metastasis takes place before treatment is given, it will progress, if radiation is effective from only two to three centimeters from the tube, without regard to the quantity of radium applied or to the length of time it is applied.

Larger quantities of radium have been tried and the time of exposure increased so as to influence cancerous cells at a greater depth, but the universal reports show that not much success has been accomplished in this direction. The overlying tissues were damaged beyond recovery regardless of the kind of filters employed. The rays of the radium in contact with the growth were too intense where it entered and too weak at a greater distance from the tubes than from two to three centimeters. Placing the radium at a distance from the surface so the rays would be nearly uniform at the point of entrance and at the distance required renders the radiation too weak even if several grams are employed. The same is not held true of the present X-ray tube which, when powerfully excited, gives off many thousand times more rays than any quantity of radium any one has ever used. It has been estimated that ninety-two grams of radium would be necessary to place the radium at the same distance in order to obtain at a depth of ten centimeters the same intensity of radiation as with the X-ray tube.

Warnekros, in order to compare the relative quantities of the rays from an X-ray tube and radio-active substances, introduced Kienboeck strips into the vagina of patients suffering from carcinoma and rayed the abdomen by roentgen tubes at a distance of twenty-two centimeters from the skin. A partial account of these tests is given in the *Archives of the Roentgen Ray*, May 1915, which is very instructive. Bumm and Warnekros concluded as follows in regard to the hard roentgen rays on deep tissues:

> We estimate that, in the treatment by roentgen rays of visible malignant growths one needs a quantity of about 300 to 500 X, in order to destroy and heal growths of two centimeters thickness. The same quantity of 300 to 500

X must reach the depth of tissues if deeply situated cancerous tissues are to be destroyed. The depths which come into consideration reach to about ten centimeters. Our experiments and observations, on dead and living persons, show that at a depth of ten centimeters, when Kienboeck strips are introduced into the cavity of the vagina and are subjected to radiation from the outside of the abdomen, the intensity diminishes from 100 to 15, that is to about one-seventh of that at the surface. To obtain, at a depth of ten centimeters, 500 X, we must give to the surface 3,500 X, and in order to apply this great quantity without serious damage to the upper tissues, only hard rays must be used with a sufficiently large distance from the skin, according to the principle of homogeneous radiation by E. Dessauer, and the rays should enter the body through different parts. Our experience shows that all this is possible and that it produces the same results in deep-seated cancers as are obtained in superficial growths.

In the treatment of any form of malignancy, the proper quantity of radiation must reach the diseased tissue, otherwise good effects cannot be obtained. Clinical experience has proved again and again that permanent results mean more than the superficial treating and removing of the visible part of the disease. Cures by such treatment are only apparent, with relapse in a short time. Attempts to cure malignant tumors with inefficient radiation has lead only to incomplete success. The roentgen rays have been found to be the only agent which is capable of checking and permanently curing well-established malignant growths in which extensive involvement has taken place, although radium is far superior in its local action on any mass situated in cavities where it is necessary to concentrate the rays. Therefore, radium applied locally, supplemented by roentgen rays to the adjacent tissue gives the ideal form of radiation because all the malignant cells can be more strongly rayed with less injury to the healthy tissues. This is a fact beyond dispute. It has been proved without doubt that many cases of inoperable cancer of the uterus have been apparently cured by radium alone applied in the vagina, and also that not our present roentgen methods alone, but a combination of both carried out scientificially seems to be the practical method and should cure more advanced cases than either alone.

Both surgery and radium are local methods of treatment and metastases in distant parts are beyond their reach in a large majority of cases. The disadvantage of surgery is that it removes a large amount of healthy tissue as well as the abnormal. There is always a limit to the removal of normal tissue in that the vitality of the patient is interfered with and consequently metastasis of the malignant cells left in adjacent tissue is hastened. The advantage of radium is that it will destroy the malignant cells without injuring the normal. It does more than cautery or removal. It destroys the cancer-cells, leaving the healthy tissue. The disadvantage is that, with any known technique, the rays do not reach beyond a certain depth and, while the disease in the superficial layers is destroyed, it is only inhibited or uneffected in the deeper parts. This shows the necessity of using radium in cavities, cross-firing as much as possible, or inserting the tube into the growth and raying the adjacent lymphatic supply as thoroughly as possible. We are still looking for the homogeneous ray. I believe that radium is the ideal form of radiation for a depth of two and one-half centimeters. We are expecting that in the near future Professor Coolidge will invent a tube which will give us this form of radiation. It is in this direction we are looking because surgery has about reached its limit. While the radium workers' results have been wonderful since filtration and cross-firing have been used, they realize that until large quantities of radium have been obtained, this form of radiation has about reached its limit.

Before this society it is unnecessary to go into detail in describing the value of homogeneous radiation and how to obtain it. But I wish to call attention to the fact that most of the radium institutes are not treating the metastases with roentgen rays, and for this reason their results are inferior to those secured by many of the Germans, who never use radium alone in advanced cases. Do they not know the limitations of radium or the value of roentgen therapy? This, I believe, is one of the reasons why many of the radium reports read thus: "This caused the disappearance of the growth. One year later the patient died of metastasis without recurrence." It appears that these radium workers are in the same place that the noted surgeon Gross was when he made the statement that he had not cured in twenty-five years a case of cancer of the breast by the removal of the breast. During the past three years I have frequently seen cases of cancer of different parts of the body which have been treated by radium which would bear out this statement.

In epithelioma or carcinoma of the tongue, mouth, throat, lower lip, uterus, or rectum, the disease is seldom seen and diagnosed before the adjacent glands are involved. In many cases the glands are not palpable but metastasis takes place long before the glands can be detected by palpation. This is something every physician should know by this time with the amount of emphasis most authorities have placed upon this

fact. Even some well-informed surgeons will tell you that they have removed all carcinomatous tissue and that post-radiation would be superfluous. It is absurd for any one to be guided by the tactile sense in determining whether there are cancer-cells in the adjacent lymphatics. Sad experience in the past has proved this to be a fact.

It is becoming a universal fact that the removal of a cancerous growth locally and as much of the adjacent lymphatic tissue as is possible or the disappearance of the local mass by radiation is a contradistinction to a cure. This might be considered a clinical cure, but a cure means the permanent removal of a malignant growth and its non-recurrence in any other part of the body. The rationale of the complete removal must include modern radiation, because even in the very early cases complete removal by surgery, no difference how early and how radically performed, removes the disease in only a certain percentage of cases. A continued study of the lymphatics in their relation to carcinoma for over twenty-five years has lead to more radical operations for their removal and has increased the numbers of cures by surgery, but still the most radical methods will cure only a fair percentage of the early cases. Bloodgood states that when deep-seated cancer is clinically malignant it is usually hopelessly inoperable. The many long and tedious operations for cancer of the breast, the most radical operations for cancer of the uterus, bladder, rectum, and throat must at least be supplemented by modern radiation which makes it more radical in order to cure the highest percentage of cases. The members of this society who have been advocating the addition of radiation to surgery, should at least be gratified that they have succeeded in convincing the best surgical authorities of this fact. Many of the surgeons realize this more fully than some of the members of our society, who are making roentgen examinations of the highest degree and doing very little radiotherapy. Our society has done much in the past and has much to do in the future to standardize methods and educate the medical profession.

The latest surgical authorities recognize the value of modern radiation as a necessary adjunct to operation and as a palliative procedure in the hopeless cases. In this connection let me cite several paragraphs from Johnson's *Surgery* just issued:

> Extensive indurated cutaneous epitheliomata involving the subcutaneous and underlying tissue, even with bony involvement, are as successfully treated by massive doses of light, moderately filtered radium as by surgical intervention and, when successful, with far better cosmetic results. . . . Inoperable lesions can be regularly reducedand the pain and discharge diminished, and latterly, with the larger amounts of radium at our disposal, a total dissipation has occasionally resulted with a fair prospect of permanent relief. . . . Inoperable tumors can sometimes be made operable and a cachectic general condition can often be greatly improved by radium applications to the offending mass or masses. The increasing success as shown by results reported in the more recent years, undoubtedly has been due to a concentrated effort to project greater masses of rays more equally distributed throughout the tumor and the immediately surrounding tissues. . . . Epithelial cancers of the uterus, rectum, and breast have seemed to be more influenced by radium treatment than the other inoperable or recurring epitheliomata. . . . Carcinoma of the cervix and uterus is anatomically well situated for radium applications, owing to its tendency to spread around the walls of the organ, leaving the cavity of the vagina, cervix, and uterus patent for the insertion of radium tubes on various applicators or in catheters. A 50 mg. tube of the element filtered with 2 to 4 mm. of foil and left in place for 24 hours will relieve pain, hæmorrhage and discharge and, in a few rare cases, the lesion has entirely disappeared over a period of months after radium treatment, the cervix and uterus tending to resume somewhat their original contour and appearance. . . . Such applications to inoperable carcinoma of the rectum have occasionally prolonged life for months and even years and saved the patient the discomfort of an artificial anus.

The symposium on "Cancer of Certain Pelvic Organs," read before the Massachusetts Medical Society, June 9, from a clinical standpoint, should be studied by every one interested in the treatment of malignancy. This symposium emphasizes the importance of more radical operations than have been heretofore performed for carcinoma of the pelvic organs, or else it suggest the addition of radium and the X-ray or some unknown treatment before it can be said we are able to cure a majority of cases which can be diagnosed clinically. The surgeons who took part in this symposium were not only of the highest rank, but each had specialized and directed his attention to only one of the pelvic organs. For the past two and a half to three years in the Massachusetts General Hospital all the cases of cancer of the uterus have been assigned to Dr. Farrar Cobb for operation, and all the cases of cancer of rectum have been assigned to Dr. Daniel Fiske. This has undoubtedly allowed each to perfect his technique to a high degree and their statements are worthy of very careful consideration. Cobb's description of the Wertheim operation in the following words certainly should prove to us that applying radium locally in the vagina would not eradicate the metastases in the adjacent glands when the removal of the tissue at such great distance from the local growth is found to be necessary:

> The radical abdominal or Wertheim operation is con-

cisely the removal of the uterus and a liberal portion of the vagina through a median abdominal incision, with thorough dissection of the ureters and bladder, with removal of as much of the parametrium on both sides as possible, the regional lymph-glands being removed only if palpably enlarged. The operation is a difficult and tedious one and the medical profession and public should be made to understand that it is an operation to be attempted only by surgeons especially interested and trained in this work.

Since, according to Cobb, 50 per cent of the cases of cancer of the uterus come too late for curative operation, and of the operable cases only 50 per cent are cured and there is an operable mortality of from 9 to 30 per cent and so much can be accomplished in the hopelessly inoperable cases, it does not seem presumptuous to suggest that each cancer patient should at least be given the benefit of modern radiation. This certainly shows that Cobb considers the ordinary operation incomplete when he advocates such a radical operation as can be done only by the most skillful and especially trained surgeons. Even then the immediate mortality in a series of cases reached as much as 25 to 30 per cent. Such a radical operation in selected cases cures only 50 per cent of the cases operated upon. His address to any one who is at all familiar with the results of modern radiation, strongly advocates radium applied locally and the raying of the entire lymphatic supply of the pelvis by the most efficient roentgen methods. Until a better cure is found nothing less should be accepted as a standard or routine, and failure to do this should be considered as much a criminal neglect as failure to use the ordinary necessary aseptic precautions.

In this symposium Dr. Daniel Fiske gave the statistics of the Harrison-Cripps cases to show how absurd it is to talk about carcinoma of the rectum as a benign condition. The statistics are as follows:

> He saw 445 patients and operated upon 107; of these 107 cases 17 per cent died from the effects of the operation, and 40 were alive five years after the operation, that is 9 per cent of the total number seen. It would be fair, I am sure, to say that not more than 5 per cent would be alive at the end of ten years.

In this symposium Dr. Arthur L. Chute states:

> The story of carcinoma of the bladder is most discouraging when we consider the small number of cures that we effect by means of operation. . . . Just enough cases remain well after operation to allow us to say that cancer of the bladder is not absolutely hopeless and to spur us to renewed effort in the hope that when we have a clearer understanding of the condition our results will be better.

Dr. Chute adds:

> It has been held that metastasis takes place late in cancer of the bladder. I doubt if this is necessarily so. I believe that operations cannot in most instances be considered radical, unless we take into account this lymphatic involvement. I believe the condition is probably this: that so long as a growth is confied to the mucous layer of the bladder there is probably no lymphatic involvement; that the moment it invades the deeper layers we have lymphatic involvement.

If it were possible to make an early diagnosis when only the mucous layer of the bladder is involved it would seem possible that such conditions could be promptly healed by radium. A few good results have been reported, but unfortunately these cases are usually diagnosed late and it is more difficult to apply radium to the bladder than to almost any other organ in the body. The danger of setting up an obstinate cystitis is always to be remembered. From studying the lymphatic supply of the pelvic organs it is readily seen how difficult, if not impossible, it is to remove the adjacent glands involved at the time of operation, no difference how radically it is performed. It is usually impossible to remove all the glands affected. The question when operating is, if the glands are affected, where are we going to stop?

A thorough study of this symposium on cancer and metastasis in general shows us why such free thinkers as Bumm, Doederlin, Kelly, and other noted gynecologists have adopted the use of modern radiation as a routine method in all their cancer cases, at least post-operatively. It is only a question of time until the entire medical profession will come to the same conclusion. The following is Kelly's report in the *Maryland Medical Journal*, July 1915:

> In nearly thirty per cent of the inoperable cases even the disease has disappeared under efficient radiation with large amounts of radium element. This was true in a group of over two hundred cases treated by Dr. C. F. Burnam and myself. It is a common sight to witness, too, the disappearance of a growth recurring in the vaginal vault after operation. It is a question for the next three years to settle, whether we will continue to operate on any of the group of cases which melt down under our radium therapy. . . . . Up to the present, radium has been used repeatedly to shrink an inoperable growth and then to operate radically.

It is not necessary to quote the results of the work which has been done and reported to members of this society. It would be well if our members would refer physicians interested to one of the many articles which have thoroughly reviewed the literature. There is an excellent article by Henry Schmitz in SURGERY, GYNECOLOGY AND OBSTETRICS, January 1915, which has undoubtedly been read but not considered sufficiently by all the gynecologists. There can be no doubt in regard to the benefits derived from modern radiation if properly given in conjunction

with surgery. The probability explaining one of the causes leading to neglect in using post-radiation is that usually too much is asked of radiation. Too often in the treatment of cancer all we see is the surgical removal of the line of defense, leaving the lymphatic glands of the adjacent tissue, which cannot be removed, untreated until a marked or clinical recurrence has taken place. Even in such instances, however, the disease is retarded, the pain relieved, and the fœtid odor diminished in a large percentage of cases and a clinical cure obtained in some cases.

During the past nineteen months, I have had a limited experience with radium in cancer of the uterus. Of fourteen cases treated, ten were recurrent and the other four were so far advanced that they were beyond the operable stage. All improved except two, in that the disease was checked, the growth diminished in size, the pain relieved and the offensive odor lessened or entirely checked. Three have been clinically cured, and one, which is still apparently cured, I reported before this society a year ago. In two other cases the disease has nearly all disappeared. These results are remarkable when you consider all were hopeless as far as any other treatment was concerned, and that four cases were taking heavy doses of morphine when they were referred.

In this connection I will report the following:

Mrs. D., age 33, was referred to me by Dr. Werder for a recurrent carcinoma following a radical operation for carcinoma of the cervix. The recurrence was marked in the vaginal cicatrix, and the hæmorrhage and discharge were excessive. On account of her age and the rapid spread of the growth, she was considered a very unfavorable case. At the first treatment she was given 2,000 milligram hours of radium, and this was repeated four weeks later. Following the first radium treatment she was given radiotherapy over the anterior abdominal wall, back, and perineum, the same method as used by Kroenig and Gauss in treating fibroids of the uterus. The same amount of roentgen radiation was given again after the second radium treatment. Four weeks later Dr. Werder examined the patient and stated that he was unable to detect any disease and considered the case clinically cured. She was again given another radium treatment, supplemented by roentgen therapy, as a prophylactic measure.

Mrs. F. was referred by Dr. Gardner who stated that he saw the case for the first time three weeks prior and that she gave a history of having had hæmorrhages for at least two years. At that time she had consulted a physician who told her that the ulceration might be the beginning of cancer. Following this, she had not seen a physician until the pain had become so severe and the discharge so offensive that she consulted Dr. Gardner, who referred her to me for radium treatment. Some of the necrotic tissue was destroyed by cautery, after which she was given 3,000 milligram hours of radium with heavy roentgen treatment as described before. At the end of two months all the cancerous tissue had disappeared except a small area, which entirely disappeared six weeks later. She was given additional prophylactic treatment and is apparently cured, but the time is entirely too short to give any prognosis.

I have not had as good results in the treatment of carcinoma of the rectum or bladder. However, sufficient results were obtained to offer this method of treatment as a palliative measure in the hopelessly inoperable cases and with the possibility of a cure, or at least further increasing the number of cures in conjunction with surgery. Three of the rectal cases were greatly improved and great palliation was obtained. In one advanced case the palliation was remarkable in that the mass was reduced in size and the patient had normal bowel movements for six months after the radium treatment.

As a whole, my results in the treatment of malignant growths of the throat with radium, have been very gratifying when considering the hopeless condition of these patients when they were referred. All were far advanced and operation had been refused except, of course, in some of the cases which were treated post-operatively. One case of carcinoma of the tonsil was reported in the *New York Medical Journal*, July, 1915. Another case which was greatly improved and in which all the disease disappeared was given additional treatment, until finally the surrounding tissues broke down, producing an infection of the throat; and while the patient did not recover, I do not believe she died of carcinoma. This case I believe would have done much better by treatment in small divided doses than by the heavy massive dose. A case of epithelioma of the inside of the cheek has been apparently cured for nine months. This case responded in a remarkable manner and the ulceration healed, leaving very little deformity. An epithelioma of the palate showed marked improvement at first, but later broke down and did not respond to further treatment. I might cite a number of cases treated, but the few mentioned briefly will suffice to illustrate my points in this paper.

The cases of epithelioma of the tongue which I have treated were all advanced cases with the usual involvement of the sublingual glands as well as with deeper metastases. While encouraging results were obtained, i.e., the local lesion decreased in size and the metastases were checked in nearly all, in only one case did the local lesion entirely disappear. So far I have not treated a favorable case and can speak only of the cases far advanced which were hopelessly inoperable. Cancer of the tongue and buccal membrane is

less influenced by radium than cancer in almost any other situation. This is not entirely due to the greater lymphatic supply, with a consequently greater tendency to metastases and the difficulty often in making prolonged applications, but it appears that there is not the same difference between the relation of abnormal and normal tissues. In order to give sufficient radiation to destroy all the cancer-cells, greater care must be exercised to avoid injuring the healthy tissue beyond repair. The same caution is not necessary in the treatment of cancer in most other situations. Also the muscles are early infiltrated in epithelioma of the tongue and infiltration of the muscle makes the disease more resistent to radiation. From the experience I have gained in the treatment with radium in such cases the results are better when the treatment is given in divided rather than massive doses. This allows the normal tissue to recover. However, in all cases except epitheliomata situated on the tongue, throat, or in the rectum, I would advocate massive doses given as quickly as possible. Then it naturally follows if this is true that you are unable to give as much radiation, and the same comparative curative results cannot be obtained in epithelioma of the tongue.

In epithelioma of the lower lip, radium supplemented by roentgen therapy is a perfectly legitimate method of treatment, provided the cases are selected by an expert and the operator is qualified. I believe this will give equally as good if not better results than the removal of a section of the lower lip with the sublingual glandular tissues. With our present methods of roentgen therapy it is reasonable that the disease in these lymphatics can be eradicated in more cases than can be done by surgery.

At the meeting of this society three years ago at Niagara Falls, I quoted a paragraph from Murphy in regard to epithelioma of the lower lip which I believe will bear repetition.

> In a series of cases published, 52 per cent of the patients who had carcinoma or epithelioma of the lip, without any demonstrable metastasis at the time of operation, died of cancer, and 76 per cent of the patients who had any demonstrable enlargement of the glands at the time of operation died a cancer death.

In the inoperable epitheliomata of the lower lip the growth can be regularly reduced in size and the pain and discharge diminished, and in some cases the disease has entirely disappeared with a fair prospect of a permanent cure. If the lesion is removed by surgery, on account of the great lymphatic supply, all the glands cannot be removed down to the mediastinum, so radiotherapy should be used as a prophylactic measure at least.

It is necessary for the operator to know the relative value of radium and the roentgen rays when combining these two agents. In carcinoma of the uterus, for instance, nothing could be expected from a local application of radium with less than from 2,500 to 5,000 milligram hours, using nothing less than 50 milligrams of radium element. Then after a rest of three to five weeks another course of treatment is usually necessary. When roentgen therapy is added it should be given in the same manner and quantity as it is used for the treatment of fibroids. How often both forms of radiation is to be repeated must be determined by the judgment of the radiotherapeutist who must be a clinician, because he cannot be entirely guided by the surgeon who is not familiar with any form of radiation. To secure permanent cures the effect of the radiation must extend from the primary growth out to the metastasis and the deleterious effect on normal tissues avoided.

DISCUSSION

CHEVALIER JACKSON: A number of years ago I did many operations for malignant disease about the nose, mouth, and fauces. Since narrowing my field of work to endoscopy and laryngeal surgery, I no longer do any operation in the regions just mentioned; but long before narrowing my field of work I had refused to operate upon malignancy, because my results had been so bad. The cases were so uniformly subject to fatal recurrence that I did not deem operation justifiable. Therefore, I am in a position most heartily to endorse and welcome the advent of the beautiful work that is being done by Dr. Boggs and other members of this society with the roentgen ray and with radium in the treatment of malignant disease of the nose, mouth, and fauces.

Now let us consider for a moment malignant disease of the larynx. Nowhere else in the human body has the surgery of malignant disease yielded such brilliant results as in thyrotomy (or laryngofissure) for malignant disease of the larynx, provided the operation is limited strictly to operable cases. In using the word operable no reference is had to the question of the patient surviving the operation. The important question is as to recurrence, and any case in which recurrence is likely should be considered an inoperable case. As demonstrated many years ago by Sir Felix Semon, operable cases are those in which the growth is strictly intrinsic and of very limited extent. Semon obtained 85 per cent cures by thus limiting his operations. His results have been equalled by Sir St. Clair Thomson, Mr. Tilley, myself, and others who have followed in Semon's footsteps in the selection of the case for operation. Unfortunately, however, cancer of the larynx is relatively very rarely discovered early enough to permit of cure by operation, either because there has been no symptom that the patient noticed early or because, for some other reason, the patient's larynx has not been examined laryngoscopically. The last time that I added up statistics of cases seen by myself in 27 years, I had done only 27 thyrotomies out of 211 cases of laryngeal malignancy. Unfortunately it requires a great deal of courage

to say "hands off" and, also unfortunately, the surgeon yields to his natural impulse to give the patient a chance, even though remote, of cure by operation, when dealing with a case like cancer of the larynx which, if left alone, yields 100 per cent mortality. But these cases that are inoperable should be dealt with by radium and the roentgen ray as advocated by Dr. Boggs.

HENRY PANCOAST: Anyone using radium for therapeutic purposes must thoroughly understand and constantly bear in mind the therapeutic action of the radiation emitted — that cells are susceptible to stimulation, inhibition of function or reproduction, or destruction, and that the administration or the dose must be of such quantity and quality as to induce the effect that will bring about the desired result.

Both roentgen rays and radium rays are employed in certain conditions for their stimulative effect, because a stimulation of the tissues is the effect that is necessary to bring about a cure. Dr. Boggs' paper deals particularly with malignant disease and one might on first thought imagine that stimulation could be disregarded in this connection because it was an effect that was not desired in treating malignancy. This effect of radiation is, however a most important one to consider for the reason that it is a very difficult one to avoid when we do not require it. I am a firm believer in the possibility of stimulating malignant growths, although I realize that there are many who are opposed to such a view. I believe that in inexperienced hands the stimulative effect of radium radiations may be readily produced, especially at the periphery of a growth where cell proliferation and the spread of the neoplasm are the most active and dangerous, and in metastases. Unfortunately, this effect is too often unwittingly produced by those of the widest experience. It is just as important that these portions of a growth receive destructive dosage as any other part.

One of the most important points brought out in Dr. Boggs' paper, is his statement of the generally accepted knowledge that where complete necrosis of tissue may be caused by radium just at the point of its application, the destructive effect does not appear to be exerted further than 2.5 cm. on an average from that point. Beyond that distance, therefore, either stimulation may be induced, or the effect is so slight as not to seriously interfere with malignant cell proliferation. As a concrete example for the application of these facts, let us take a case of inoperable carcinoma of the uterus, with extension into the broad ligaments and possibly with lymphatic metastases. How foolish it is to expect a permanent cure from the application of radium to the cervix, even though we may obtain a most gratifying temporary local result, if the malignant cells proliferating at a distance beyond 2.5 cm. in the primary growth or in metastatic deposits cannot be destroyed. We have accomplished no more than a localized destruction in a widespread growth. Such treatment is frequently followed by a more rapid invasion of the surrounding structures.

Further discussion would be unnecessary if we were obliged to stop here because we had reached the limit of our possibilities, but such is not the case. There is still one very effectual agent to be used and one that is too frequently disregarded by those who employ radium alone. If additional and completely effectual radium applications cannot be made at other points, an additional effect may be produced by cross-fire roentgen radiation, the object of which is to intensify the action of the radium radiation beyond the point where its destructive effect ceases. In the case of uterine carcinoma when there is the least suspicion of extension beyond the limit of control by radium it would certainly seem as though our patient had not received adequate treatment unless the radium applications were supylemented by such cross-fire roentgen radiation as is employed in the treatment of a uterine fibroid. Each agent alone has accomplished some good results but both together should accomplish far more.

Cancer of the rectum has not responded nearly so favorably to radium treatment as has carcinoma of the uterus. I do not believe that a growth in the rectum can be properly and adequately treated unless a preliminary colostomy is performed. At least this is so in the large majority of cases, and this fact is not nearly so fully realized as it should be. Without the operation, we are prevented from pushing the treatment as energetically as we should because of the discomfort of the patient due to the effect of the radium on the mucous membrane of the bowel and the continuance of the function of the part. Discomfort is often greatest in the sphincter region, and when this area is invaded, the treatment must be most vigorous because of the greater likelihood of metastasis.

Our experience has been entirely in accord with that of Dr. Boggs in connection with cancer of the tongue, throat, and rectum. Too vigorous radiation is to be avoided because of the danger from extensive devitalization of healthy tissues. The dosage should be much less at one time, as a rule, then in uterine carcinoma, and should be divided and repeated.

CAUSES, MECHANISMS, AND TREATMENT OF FLAT-FOOT

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ALTERATION in the normal poise of the body which gives rise to pain and tenderness in strained muscles and ligaments is a disorder too often not recognized; the condition is frequently mistaken for "rheumatism" and inappropriate treatment is often administered. The distressing symptoms that are found in the early stages of flat-foot and pronation can almost without exception be traced to some systemic cause as a predisposing factor. Toxic conditions arising from altered physiological processes, infections, etc., predispose to pain and weakness in muscles and ligaments owing to the increased irritability of the cellular elements; consequently physical structures under the influence of this abnormal state, in performing their normal functions, will show symptoms of overstrain.

When the arch is obliterated, the toes abducted, and the patient walks with that peculiar limping gait, the diagnosis is apparent even to the layman. In the earlier stages of flat-foot a keener insight is required to determine the significance of a slight decrease in muscular tone, a minute alteration in structural relationships, and slight changes in the weight-bearing postures. Moreover, in the incipient stage when time can be saved and best results can be obtained, skill and good judgment in the construction of the proper shoe are most essential.

The causes of flat-foot are the conditions which alter the structural relationships and lessen the power and tonicity of the muscles and ligaments. If the general musculature becomes flaccid, the muscles or groups of muscles that receive the greatest amount of strain are the first to give way. In the treatment of the malady in question therefore, it is important to make a thorough study of the mental, nervous, and physical status of the patient, acquiring an intimate knowledge of the condition of the circulatory, genito-urinary, gastro-intestinal, and respiratory systems, and to study the effect of any superficial glandular infection present and of the mode of life, since careful observation has found constitutional conditions to be primary factors. The next step is to study the positions in weight-bearing. The vicious habit of toeing-out is a very general cause.

In this position the toes fall far outside of the plane of weight-bearing, the force of the body weight in walking is oblique to the arch of the foot and an inward cross strain is produced. The position of the leg in which the toes fall outside of the line of progression shortens the stride, lessens the important element of thrust of the great toe, and diminishes the force of propulsion. Persons in whom this toeing-out position is exaggerated have a peculiar trudging gait and readily become fatigued in walking. It is an astonishing fact that a wide divergence of the toes has been a custom ardently insisted upon for many years; the military rule and the custom in many physical training institutions has been a divergence of the toes in standing of from 60° to 90°, and in walking a divergence of about 45°. When the weakness of this position, the loss of propulsive power, and the diminution of the stride are considered, the reason is apparent why athletes, and savages toe in from a natural conservative impulse. The toeing-out position affects not only the foot but also the superimposed structures. The legs are externally rotated, the knees are subjected to a twisting force, and the joints are strained. The outward rotation of the femur favors a backward rotation of the pelvis on its transverse axis with elevation of the pubis and a consequent decrease of the normal lordosis. In addition, the hips and shoulders are displaced forward, the lower thoracic curve is increased, and a stoop-shoulder position is favored. The converse of this condition is absolutely true. The toeing-out position also is a potent factor in the development of hallux-valgus, because the cross strain combined with narrow toes of shoes and stockings, drives the toe outward at every step.

Shoes which hold the foot in constrained positions produce painful callosities, deranged relationships, disturb function, and are a fruitful factor in the production of flat-foot. The wearing of ill-fitting, badly shaped shoes, especially with high heels and tight-laced constricting uppers, and narrow toes, places the foot in a cramped malposition, prevents free normal action and produces muscular weakness, atrophy, and the loss of tonicity. Many persons who wear this type of shoes have severe pain when they attempt to walk without shoes and in many cases standing with the feet in a normal position is impossible.

Occupations unassociated with other predisposing conditions, in rare instances produce muscular weakness and flat-foot in normal individuals.

Local and pathological processes, trauma and congenital defects, each have a significant bearing on the causation of flat-foot. A shortened tendo achillis which diminishes the flection of the foot on the leg in walking, tends to weaken the tarsal structures; if pronation of the foot and abduction of the toes do not compensate the loss in flexion, the arch gives way. The cause, whatsoever it may be, bears a direct relationship to the deformity.

It is well to bear in mind the anatomical and mechanical features found in normal subjects. The normal position of the lower extremities in bearing the weight of the body is such that a plane passing through a point in the anterior superior spine of the ilium parallel to the line of gravity will pass through the patella, the lower end of the tibia at its malleolus, will coincide with the inner surface of the os calcis, and pass through the axis of the second toe. Obviously the superimposed weight falls to the inner third of the heel and must be borne chiefly by the supinator muscles. The long plantar flexors of the toes exert a force between the os calcis and the phalanges which tends to approximate these structures, gives added support to the longitudinal arch, and adds stability to the foot. The force of the tibial muscles fixes the scaphoid against the astragalus, gives stability to the latter, prevents its downward and inward movement and a pronation of the foot. The astragalus secured by the malleoli has but slight lateral movement. Normal pronation and supination are made possible chiefly by movement between the astragalus and os calcis and the astragalus and scaphoid. The weight of the body is transmitted to the ground through two pillars: one, the comparatively small undersurface of the tuberosity of the os calcis; the other, the distal ends of the metatarsal bones and the phalanges. These two pillars support the longitudinal arch. The point of bearing of the former is fixed, the latter support is movable and pliable, giving control in equilibrium and resiliency to the stride. The obliquity of the plane of the mediotarsal joint causes a lateral movement of the toes in dorsal and plantar flexion of the foot at this mid-joint. There is a widespread conception that the distal heads of the metatarsal bones form an arch which has a bearing point at the distal tuberosity of the first and fifth metatarsal bones. This is an erroneous impression since in most feet in the weight-bearing posture the heads of all of the metatarsal bones transmit weight directly to the ground; consequently, conditions ascribed to the falling of the anterior arch are due to other causes. With the foot and leg in the normal weight-bearing position, the great toe is directed slightly inward. This relationship is generally found in non-shoewearing people. Their arches are normally low but give no subjective symptoms; the antetarsus is broad, the toes are straight, and the muscles controlling them are well developed. The second toe is directed straight forward. Each toe has an unrestricted action in performing its function and adds its important rôle to the stability of the foot. Flexibility of the feet and toes is imperative in correction of altered structural relationships and in maintenance of correct balance.

The mechanism of altered relationship and disturbance in function depend upon the structures affected. If the force of the tibial muscles is diminished, the support of the tarsus is lessened on its inner side and pronation results without alteration in the contour of the arch if the plantar structures are normal. In cases of marked relaxation of the tibials associated with relaxation of the internal lateral ligaments, the head of the astragalus moves inward; by virtue of its increased freedom, it rotates forward and downward and is tilted inward, the os calcis rotates inward on its longitudinal axis, tends to rotate inward on the vertical axis, weakness of the plantar structures occurs, the arch is diminished and the condition of talipes valgus is produced. If the plantar structures are weakened or relaxed and the tibial muscles prevent an inward movement of the tarsus, the normal arch is diminished, the foot anterior to the mediotarsal joint is abducted and talipes planus results. When there is diminution in the normal power of the tibial muscles and plantar structures, the arch tilts inward and is diminished vertically according to the loss of muscular and ligamentous support and *plano pronatus* is produced. Likewise combinations of the various malpositions may be found.

Symptoms are manifold and pain resulting from foot strain may be found at almost any level of the body mechanism. Symptoms may be local, as pain or tenderness or both in strained muscles, ligaments and tendons; or they may be associated, as pain or tenderness or both in the knee, hip, spine, etc., owing to the strain resulting from static disturbances. Again, pain as a result of irritation of the terminal branches may be referred along the nerve-trunks even to the spinal roots. Changes in structure are frequent

occurrences as traumatic arthritis of the knee-joint, deformity of the head of the femur, scoliosis, altered position of the shoulder girdle, etc. The unequal wearing away of the sole and heel of the shoe, the characteristic posture, the trudging gait, mental apathy, early fatigue, etc., are factors which guide the diligent, not only to the nature of the condition but especially to the cause.

In methods of treatment there has been a great diversity of procedure, but fundamentally a simple rule can be deducted—the partial or complete removal of the cause and the establishment of conditions that tend to restore normal muscular power and tonicity, and a normal poise of the feet as well as of the body. The nature of the treatment must necessarily consist of measures that will meet the needs of the conditions found. Unfortunately, foot troubles are overlooked or neglected until more complicated conditions transcend the first simple disability; nevertheless a limited experience in the management of foot disorders has convinced the careful observers that the only rational procedure is the restoration of normal function by the removal of the cause of the disability and the establishment of normal conditions, not by the support of weakened structures. Any condition that lessens the general tonicity must be removed and that loss in tonicity restored by medication, good food, and proper hygiene. Muscular power must be increased by exercise, massage, heat and cold, electricity, passive motion, etc., as indicated. The poise of the body in standing and walking must be so regulated as to suit the individual case. When occupation is a contributory factor it must be modified as much as possible to mitigate its effect. The proper construction of the shoe is most important in the establishment and maintenance of normal weight-bearing conditions. The shoe must not interfere with the functions of the foot. The heel should be high enough to suit the needs of the individual case. The sole should be formed so as to adduct the anterior part of the foot, applying pressure along the outer side of the fifth metatarsal bone, not to the toes. The inward flexion will then take place at the mediotarsal joint, the foot being held in a straight line forward from this point, thus throwing the center of gravity to the outerside of the foot and increasing the arch. The sole should be broad enough to allow a requisite spread of the toes in the free performance of their function. The counter should fit the heel of the foot closely and hold it securely. The upper should fit accurately but should not constrict the ankle. A tight upper impedes the circulation, favors congestion and atrophy of the structures below, and hampers the action of the tendons at the ankle, and as well restricts the function of the foot. In designated cases a wedge in the inner conformation of the heel aids materially in maintaining the foot in the proper position of weight bearing. The wedge should give the proper tilt to the individual foot and be removed after it has served its temporary purpose. There is rarely any indication for wedging the inner conformation of the sole since the object of the wedge is to tilt the os calcis outward and correct the tarsal torsion which has taken place. If both heel and sole are tilted outward the position of the os calcis and ball of the foot remain relatively the same and the purpose of the mechanical principle is lost. A Thomas heel is often serviceable in bolstering up the os calcis and in preventing an inward rotation on its longitudinal axis. When a rigid flat-foot, a shortened tendon, parolytic or traumatic conditions are encountered, they require radical treatment in addition to the above measures. The rigid-flat foot must be rendered flexible by manipulation followed by fixation for an appropriate time and subsequently massage, passive motion, etc. The short tendons must be lengthened and traumatic conditions treated as indicated. Radical measures should be employed with ultimate discretion. Often operative interference will add rigidity to the foot and make the desired flexibility of the foot impossible when muscle power and tone have been restored. After flat-foot and associated symptoms have been relieved or cured the patient must be taught a mode of life that will prevent a recurrence of the trouble.

A condemnation of foot plates, as used in countless instances, cannot be too strong. It is important to emphasize the dangers incident to the use of ready-made arch supporters which unscrupulous shoe dealers and brace makers urge upon the customer, not because he has the wisdom to advise treatment, but because the traffic is profitable. Alluring statements relative to the causes of "painful feet," "weak ankles," "broken arches," "fallen arches," etc., infest the advertising columns of nearly every publication and erroneous claims are made of the magic cures made possible by the use of designated devices. Still more infamously do many of the shoe dealers, brace makers, and department-store clerks make a diagnosis of "broken arches" and graphically picture to the patient some fatal termination if the contrivance is not used, thus inveigling the patient into almost certain loss and injury. The ignorant and reckless use of arch

supporters in the treatment of conditions due to defective muscles is unscientific and subjects the trusting public to fraud. The practice of giving careless advice—"get a pair of arch supporters"—when employed by physicians is an act to be lamented! It is difficult to believe that persons of normal intelligence can be decoyed into the notion that the pernicious devices have some property or magic by which the many ailments of the foot can be instantaneously and permanently cured; and yet the public is being constantly, not only defrauded of money, but its individuals are also the victims of malpractice. The physician who uses, temporarily, a proper plantar support, is often criticized and condemned by persons who have been cheated and deceived in the hands of an apparently learned salesman totally ignorant of the conditions and requirements of the case. Patients are constantly appearing for treatment who for years have worn flat-foot plates, still suffering from the disability and unable to discard the supports, although in the beginning of their use more or less of comfort was derived. The use of rigid arch supports, over a period of several months, although they relieve for a time distressing symptoms, weakens the muscles of the leg as well as of the foot and tends to make the patient a slave to its use. In the majority of cases such temporary employment of arch supporters is unnecessary if static errors are corrected and methods to restore muscular tone and normal poise are instituted. If the surgeon's aim is to strengthen the weakened structures, he is justified in employing some temporary support to relieve symptoms if that temporizing be a matter of days only. In the same manner as a splint is discarded after the fracture is repaired so should the use of a plantar support be terminated when it has served its purpose. In case of fracture the essential treatment is fixation and rest of the part. The ideal treatment of painful flat-foot (in cases in which every step gives agonizing pain and constant standing is distressing) consists of rest of the feet and the application of appropriate treatment. Unfortunately, this cannot always be done, since in cases in which the malady is due to occupations that require foot strain, the victims must find relief that will enable them to pursue their work.

Flat-foot may result from any one or more of a multitude of causes. The predisposing and causative factors should be learned, the mechanism of the development of the condition and the pathology should be ascertained and a knowledge of the habits of the patient should be acquired. With the essential data in mind, the physician should employ constitutional and local treatment suited to his case and teach his patient the cardinal laws of prevention if he desires to accomplish a permanent cure.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD NOVEMBER 19, 1915, WITH THE PRESIDENT, DR. CHANNING W. BARRETT, IN THE CHAIR

INDUCTION OF LABOR

DR. CHARLES B. REED read a paper entitled "Induction of Labor at Term: A Report of 100 Cases." (See p. 294.)

DISCUSSION

DR. J. CLARENCE WEBSTER: I was working in Europe when the Champetier de Ribes bag was introduced into practice, and was one of the first, outside of France, to employ it. I very soon became convinced of its advantages, and have used it ever since as the best means of inducing labor. In recent years I have preferred the American form of the bag as it is lighter in construction and cheaper.

Dr. Reed's paper is a plea for the induction of labor on a date fixed by the obstetrician after he has convinced himself that the fœtus will be fully matured at that time, in preference to allowing Nature to take its course.

Such a proposal is likely to meet with violent opposition in the medical profession, especially among those who believe that Nature is usually right and should be allowed to take its course. Dr. Reed must be well-fortified with good arguments to prove that his procedure is more advantageous for mother and child.

Induction of labor is a well-recognized method of delivery, and has in the past been restricted to special cases. When carried out in a hospital, under expert care, it is attended with very little risk. If Dr. Reed means to suggest that it should supplant Nature's method in general practice and find universal employment in the profession, much harm will be done. The procedure necessitates a thorough aseptic technique, some manual dexterity, and continued watchfulness, such as best exist in hospital practice.

Dr. Reed speaks confidently of being able to determine the maturity of the child with accuracy. I cannot agree with him. Until we know when conception begins we cannot be certain as to this point. All the data on which the determination of the maturity of the ovum is based are variable; e.g., the escape of the ovum from the ovary, the length of time of its passage to the ovary, relationship to coitus, the meeting of spermatozoa and ovum, relationship to menstruation, the size of the uterus or fœtus, the quantity of liquor amnii, quickening, etc.

Dr. Reed relies on Ahlfeld's measurement at term, but most obstetricians regard this as only relatively valuable, and not capable of giving absolute information as to the maturity of the fœtus. Variations in the size of the full-time child are so obvious as to make one skeptical as to the reliability of Ahlfeld's method. With all the data at our disposal we may often be in error two weeks or more.

However, as Dr. Reed states, there is apparently little difference, as regards vitality, between a full-time fœtus and one short of term by a week or even more. Consequently, the opposition to his procedure must be considerably minimized if this standpoint is alone to be considered, because an expert obstetrician would rarely make an error of such importance, in estimating the maturity of the fœtus, as to greatly lessen the chance of its survival.

I have long held that premature labor is advisable in cases in which the obstetrician in convinced, from a consideration of all available data, that pregnancy is continuing longer than the average, particularly where the fœtus is large. Induction of labor in such cases probably reduces the risk both to mother and child.

Dr. Reed has called attention to one great advantage of labor induced by the bag — the shortening of the first stage.

In the great majority of cases when the pains begin they continue to recur with shortening intervals until dilatation is completed. Occasionally, they may be weak, irregular and extend over a long period of time, but this variety is much rarer than among cases of spontaneous normal labor.

In the Presbyterian Hospital it has been customary to introduce the bag in the forenoon. In the majority of cases labor has not been completed until after midnight. Very few have terminated within six hours, but a considerable number between six and twelve hours.

Occasionally, pains are started and cease entirely. The addition of a weight to the bag is an additional stimulus to the uterus, but as a rule it is safer not to use it. Cases in which labor is induced must be watched carefully, because occasionally malpositions and malpresentations may be brought about. They should be discovered by the time the cervix

is well-dilated so that they may be properly dealt with.

My technique is the same as that of Dr. Reed only in cases in which I cannot dilate the cervix sufficiently for the introduction of the bag with my fingers. Ordinarily, I administer the nitrous-oxide-oxygen mixture for a few minutes while my glove-covered hand is introduced into the vagina. Dilatation of the cervix is usually easily effected with the fingers and the rolled bag is passed along the palm and introduced into the cervix with the fingers.

I consider a rigid cervix as unfit for induction of labor by the bag. It is apt to be unsuccessful. Such a condition is far more suitable to the employment of vaginal or, sometimes, abdominal cæsarean section. Dilatation of the cervix with metal dilators may cause laceration which may be increased with the progress of labor.

Dr. Walter S. Barnes: I have been doing this work for about fifteen years, and in the labors that I have induced during that time I have had no trouble from infection. I have lost no mothers. I cannot give you as accurate reports as Dr. Reed has given you of these cases, but my results have been very much the same. The labors have been a little longer. I introduced into the cervix, after it had been tested out and measured as to capacity, two Barnes bags of large size, which were used in connection with a hand-syringe.

As regards the vulsellum tearing the cervix, I have not used enough force to pull the instrument out through the cervix. As regards rupturing the membranes, it has been the exception. The shape of the bag is such that it allows free exit of any discharge, and there is no chance for the secretions to be pent up. In this respect the Barnes bag has an advantage over the Voorhees bag. The results have been uniformly good.

As to occipitoposterior positions, I have been able to correct these in many cases by introducing my hand into the uterus after placing the patient under complete surgical anæsthesia. If the head fails to rotate with the methods of posture, etc., I push up on the caput, place my hand in the uterus, taking the ear as a guide, apply the other hand to the shoulder and turn to the long axis of the uterus, which is safer than version of the head. I allow the head to come down. If it does not, I introduce forceps and pull it down. Labor will then soon be terminated. I save the patient from extensive damage which we see so often following occipitoposterior presentations with laceration of the perineum.

I think we will all come to see the time when this procedure will be adopted more frequently than it is at present.

Dr. Charles E. Paddock: I hardly know what to say in regard to the strong position taken by the essayist. His treatment of women, at term, is certainly a bold one and in the hands of others less skilled would seem like meddlesome obstetrics. It is so at variance with the teaching of the past generation, and is not sanctioned, as far as I know, by any of the modern textbooks; it brushes aside the attitude taken to "let Nature take her course" as far as possible. Of course, we are progressing, and I will not say that this is not a step in the right direction, but I would be rather reluctant to attempt bringing on labor at a certain time in every case. I make a practice to advise that pregnancy be interrupted if the patient is a few days past term, but I do not insist that such advice be accepted, but when I say a patient is at term I am sure she is so and do not depend upon the measurements of the baby *in utero* to inform me. A majority of my patients are seen a few days after the first missed period and this sign, together with other signs and symptoms soon occurring enables me to say just where this woman is in her pregnancy. In ward cases, or cases seen late in pregnancy, I claim it is impossible to say definitely when the woman arrives at term. If I decide to terminate the pregnancy, my custom is to give the patient quinine and castor oil, which will in over 50 per cent of the cases induce labor. Knowing this, why then should the patient be submitted to the risks consequent upon insertion of a bag?

I cannot agree with the essayist upon the ease with which the bag is inserted; neither do I find the cervix so fully dilated that the bag can be attempted without first dilating the cervix, requiring an anæsthetic; neither do I find the average patient is willing to submit to the operation. Again, I believe that a routine treatment, such as outlined, will cause displacements, prolapse of the cord, and occasionally infection. I am willing, however, to be convinced, and Dr. Reed has kindly consented to permit me to see him at his work.

Dr. Rudolph W. Holmes: There can be no question that the hystereurynter is one of the most valuable adjuncts to obstetric procedures we have. I have never used it in a case I considered normal. However, it has been employed repeatedly, with signal success in pathological cases. For months this question of the induction of labor at so-called term has been intimated, but I had not taken the matter seriously, for there is no more justification in such a procedure than there would be in performing any other obstetric operation without a valid indication. At the present time there is no department of medicine where unmerited censure and criticism are bandied about as in obstetrics. To apply this procedure without indication, in every patient, as a routine, is merely inviting still more opprobrium on a maligned specialty which already has more threats of malpractice than any other branch of medicine. To have a catastrophe happen following the use of the bag in a definite indication is justification in itself, but to have it follow where the reason is largely a matter of the physician's convenience will offer no justification in his conscience, or an extenuation in the minds of the laity. There has been so much heard recently of meddle-

some midwifery in connection with unjustifiable cæsarean sections, and the promiscuous use of forceps, that I believe it extremely ill-advised to recommend this procedure as a routine.

As Dr. Webster has stated, it is impossible to determine the date of maturity positively, as we have no conclusive data as to the date of fertilization. With all the data of the single coitus, date of the last period, day of perception of life, and finally of lightening, one may easily be led astray in determining the date of labor. The determination of maturity by means of the Ahlfeld and Perret methods frequently leads to fallacious deductions, as a large baby may be actually premature while a small one may be fully ripe. As we know positively that it is impossible to fix accurately the date of maturity, so, likewise, without this definite data we cannot say the child is post-mature. Any deduction made one way is equally fallacious for the other. In Dr. Reed's report he shows that one baby was inadvertently brought into the world at the seventh month. Not so long ago a cæsarean section was done at this same period because the operator made a mistake in computing the maturity. This is not a culpable error, but typifies the inexactness of our working knowledge.

The wife of a friend came to me when she thought she was about five months pregnant. The enlarged, discolored breasts contained colostrum; she imagined she felt life; she had not menstruated since a week or two before marriage. Her baby was born 13 months after her wedding. No one would think for a moment she had a pregnancy of that duration. At the time she came to me the uterus was soft and hardly perceptibly enlarged. The fact of an intense maternal instinct, a profound impulse given by married life, or a disturbance of ovarian secretion had produced in her a pseudocyesis. Similarly explained is the woman who came to me, convinced she was pregnant yet there was no uterine enlargement. The baby was born just a year after her first visit. No one would maintain that she had a pregnancy lasting a full year. You all know, by act of Parliament, one of the ducal families of England continues its line uninterruptedly in spite of the fact the heir was born two years after the death of the "father."

I certainly have used the hystereurynter at least a hundred times in pathological cases. In some it is remarkable how quickly and effectively it acts. I recall a placenta prævia where the bag was used, and certainly within ten minutes the bag was expelled, the child delivered by version and extraction, and the placenta removed and the uterus tamponed. On the other hand, all of ten years ago, I repeatedly had to place the bag covering a period of five or six days, without avail, and finally had to secure dilatation by incisions. The bag Dr. Reed shows does not secure full dilatation— it produces a little more than half dilatation.

The fact that Dr. Reed had nine occipitoposterior positions is suggestive. Of course, accidents will happen in one series which may not recur in another, but it is a logical belief that the bag had dislodged the head. Anyone who argues that the bag does not dislodge the head is preaching sophistry or basing a statement on error of observation. It is true in obstetrics as in other connections that two bodies cannot occupy the same space at the same time. If abdominal palpation is invariably followed after the bag is introduced, it will invariably be found that the head is displaced. That good fortune attends us, and the head returns to its earlier position after the escape of the bag does not militate against the statement at all. It is a fact that the use of the bag offers an increased liability of a prolapse of the cord, or some other fœtal member, than is present in normal unaided cases.

It is an inviting proposition to place a bag at a time convenient for the obstetrician, and know that within a reasonable time the case will terminate. But it is a specious argument that it is done because labor is so essentially a pathologic process.

In this connection I cannot see the expediency of using the bag when castor oil, aided by ten grains of quinine, in those who can tolerate the drug, will bring on labor in at least 75 per cent of cases *if the woman is at or near term.* I am convinced that it is exceedingly remote that castor oil will precipitate labor in a woman far from term. If an error is made in the time of the exhibition of the drug no harm is done if it is before term. If the bag is introduced in woman, where the maturity is uncertain, or she has not reached that period, the baby will probably pay the penalty for the error. Castor oil as a means of induction of labor at term is not so spectacular as the introduction of a bag, but at least it does no harm.

DR. RACHELLE S. YARROS: It is true that in the last decade we have all been taught to interfere as little as possible in our obstetrical cases; to watch carefully and let Nature do her work. This is apparently a perfectly legitimate protest against the meddlesome obstetrics practiced by the old midwives and doctors who were continually dilating the vagina, cervix, and giving ergot. Watchful expectancy has served a splendid purpose, and we must not underestimate its value. But with great change in surgical technique, with increased general knowledge and practice of asepsis as well as the growing custom of patients to go to the hospital for childbirth, it would seem that the new ideas for relieving labor pains and reducing the duration of labor through medical or surgical methods, might be considered with greater safety.

As Dr. Webster already stated, the bag is not a new idea. We have all used it in appropriate cases with good results; we have all found cases where the bag could not be used and where the bag remained for many hours without the results that Dr. Reed describes.

The idea of inducing labor at a given time in a perfectly normal case is decidedly a new idea. I am somewhat surprised that Dr. Reed finds no

difficulty in obtaining the consent of his patients. Most patients that I know, intelligent and ignorant, would insist on waiting until Nature begins labor. The only reason for inducing labor before, if I understand Dr. Reed correctly, is simply because it is convenient for the physician. Perhaps it is a good reason, but we can hardly expect the lay public and most of the profession, to view it favorably. If, however, the introduction of the bag will actually prove from a further investigation, to reduce the duration of the first stage of labor, and if we can safely satisfy ourselves that with the greatest aseptic care we are not increasing the danger of infection to the mother, and that we are not converting a certain number of normal cases into abnormal ones, Dr. Reed's contribution will prove of great value, because we all feel that the first stage of labor in many cases is far too exhausting to the mother. For many years we have felt that this exhaustion is no doubt responsible for the still high morbidity that follows normal childbirth.

Dr. N. Sproat Heaney: Apparently the experience of different men with the introduction of the bag is quite variable and no one seems to have had anything near like the favorable results that Dr. Reed has had.

There are two or three points brought up in the discussion and also mentioned by Dr. Reed to which I desire to refer. First, the incidence of occipitoposterior presentation, whether nine cases in a hundred are an abnormal percentage. I think if we have only nine cases in a hundred it is not very large. It is in fact unusually small.

Any safe means of shortening the first stage of labor, is certainly desirable. One thing that we must all remember in Dr. Reed's technique is that in every case that is not having good strong labor pains at the end of an hour a weight is attached to the bag. That is not the usual technique. Very few put on any weight except in cases of placenta prævia when only enough weight is added to stop hæmorrhage. Lately I have been using traction in a larger number of cases. Instead of a weight and pulley, I attach a piece of rubber tubing from the bag to the foot of the bed by means of artery forceps. By the use of an ordinary baby scales one can regulate the amount of traction.

I wish Dr. Reed's cases had not been so varied. These are consecutive cases. I wish he had taken for our instruction a hundred consecutive cases of normal pregnancy at term, throwing out all unusual conditions, such as the occipitoposterior and breech presentations, nephritis, small pelvis, etc. We could then be much better able to judge as to the real merits of the bag.

Were those transverse cases you had primary or secondary to the bag?

Dr. Reed: Primary.

Dr. Frank Cary: In the last few years, since the introduction of "twilight sleep," the use of gas-anæsthesia, and now this method of delivering patients, I am glad I am alive at this time. [Laughter.] I am a little inclined to let my patients at least go into labor before I undertake to do something. My reason for doing this in the few years I have been connected with hospitals is that I have seen some very good men induce labors on account of the tremendous size of the child, which were not so very large. I have not been able to make out when labor should begin. I find it difficult to tell when the patient is at full term, and until I can do that I shall hardly be inclined to resort to artificial means of delivering my patient until she at least begins labor.

As regards the use of the bag, I did not hear all Dr. Reed had to say, but I favor the use of the bag where it is indicated. Obstetricians differ as to where it is indicated. The rapidity with which labor can be terminated I do not think so much depends upon the use of the bag or upon the obstetrician as it does upon the wishes of the patient that the doctor is operating on. Some of these cases will resist the bag for hours, as any one knows who has undertaken to use it. My first work with Jaggard was done years ago when the bag was used in most cases of eclampsia, and on account of that condition it was necessary to deliver these patients rapidly.

I am certainly interested in what I have heard about the use of the bag. I may not see the force of using it because I have not been delivering patients according to schedule time.

I am very sorry I did not hear the paper, but I do believe in the use of the bag under certain conditions, and perhaps after I read the whole paper I may be inclined to induce labor that way; but at present I am inclined to wait a little.

Dr. Robert T. Gillmore: For the past year I have observed Dr. Reed's Wesley service with profit and interest and must confess that his method has enabled me to bring on labor with less apprehension than I previously possessed.

About three years ago I induced labor prematurely on a patient at Wesley Hospital for a bad albuminuria. Owing to the fact that I did not apply traction to the bag as Dr. Reed now recommends, I was obliged to introduce two bags.

Last August I induced labor again for the same reason. About ten o'clock in the morning I introduced a bag, applied weight to it, and at five in the afternoon delivered her of living twins without complication. The obstetrical procedure was done under twilight sleep produced by scopolamine, which I have used with more or less satisfaction for the past eight years.

In conclusion I wish to state that I have not had the difficulty in introducing the bag that a number of obstetricians have reported. In only one or two cases has it been necessary for me to use my fingers in dilating the cervix. The bag slipped in without traumatism or the use of force, and in the future it is my intention to resort to this method in hospital practice more frequently than I have done in the past.

Crile has demonstrated the effects of exhaustion in the cerebrum and in my judgment Dr. Reed is justified in his statement that the use of the bag decreases mental and physical exhaustion and is an important factor in the prevention of sepsis.

DR. CAREY CULBERTSON: I regard Dr. Reed's paper as an interesting contribution to our advancement in the management of labor.

As Dr. Webster has said, we have used the bag in the induction of labor at the Presbyterian Hospital after the patient has gone to what we call full time, in uncomplicated cases, for many years with results that have been satisfactory. All of them were not perfect, as not all spontaneous labors are perfect. For some months I have used the method here outlined by Dr. Reed in my private and clinical cases arbitrarily at what we call term. I think that all obstetricians will agree that it does not make much difference whether a baby is born, so far as its condition goes, on the 280th or the 290th day. When they are born at this time, spontaneously, we say the patient is at term. Therefore, I do not see any great objection to inducing labor any time during this period, from the two hundred and eightieth day on. I have been inducing labor in this way, choosing the day when the patient expresses the desire to have her baby, and I see no reason why we should not be arbitrary in that matter. I have not had as many cases as Dr. Reed reports, but I am satisfied, as he states, that the first stage of labor is materially shortened, and the entire labor is shortened from four to eight hours. The second stage, of course, is not materially altered, but the first stage is definitely shortened. As a rule, we put the bag in in the morning, as early as possible, and the baby is born by supper-time or at bed time. In my last case the bag was put in at nine o'clock in the morning and the baby was born at half-past two in the afternoon, the patient's third child.

As far as displacement of the head goes in the introduction of the bag, in a multipara that is relatively unimportant, because in the average multipara the head is not in the pelvis. In the primipara where the head is in the pelvis before labor it has become molded. It may be displaced by the bag but it comes down again as soon as the bag is expelled from the cervix. I have had prolapse of the hand following the introduction of the bag, but not a prolapse of the cord. So far as occipitoposterior positions are concerned, if the head comes down in that position I assume that there is more room for it posteriorly than anteriorly. Its management is not such a difficult procedure, and I see no reason why expert obstetricians should be afraid of occiptoposterior positions. These usually require low forceps extraction, though a certain proportion terminate spontaneously. As a rule, I find that the head returns to the pelvis, as soon as the bag is expelled from the cervix into the vagina. While rubber-bag induction may cause displacement of the head I fail to see how it would prevent anterior rotation since rotation occurs when the head is low, that is, after expulsion of the bag. Occasionally there is a case where labor does not ensue after the introduction of the bag; there are occasional cases where labor cannot be induced by any artificial means, and the patient must be dealt with surgically. But that does not happen very often. Once in 12 or 15 times is the impression I have now of the proportion of cases in which the bag does not induce labor. Where an effort is made to induce labor prematurely, on account of toxæmia, the pre-eclamptic condition, or something of that sort, occasionally labor will not be induced. I have seen two cases of the so-called pre-eclamptic condition where labor did not ensue from the introduction of the bag.

I use a larger bag than Dr. Reed has shown and I have never found it necessary to put the bag in two or three, or four or five times as Dr. Holmes suggested. I should not reintroduce it one day after the other if it were ineffectual. I would let two or three days intervene between the efforts at induction. Indeed, if the patient has not come into labor, the bag should be removed in 24 or 30 hours. I do not find it necessary to employ traction as a rule. Where I do, I use an elastic tube, as Dr. Heaney suggested, which I first saw used in Vienna in 1903. It is important not to make too much traction, not to keep the bag too tight in the cervix. Enough to keep the tube taut is all that is required.

Labor pains come on at once with the introduction of the bag in some cases, and in nearly all there are definite, regular, rhythmical contractions within one or two hours. The pains are more frequent and more prolonged than in a spontaneous first stage. In this way dilatation and effacement are brought about more rapidly and the first stage definitely shortened. Nitrous-oxide analgesia controls the suffering when it becomes as severe as the terminal pains of the first stage in spontaneous labor.

DR. MARK T. GOLDSTINE: I have had the opportunity to watch Dr. Reed's work closely and have been much interested in it, and can vouch for the results he has stated in his paper. The technique has been worked out carefully, and not only that, he has trained his assistants in the management of the bag so that if Dr. Reed is called away, after the bag is introduced, the case is under the close observation of a person who is skilled in managing these cases.

I think the impression is that the technique of the introduction of the bag is simple. I have just the opposite impression. I do not think that the management of the case, after the bag is introduced, is as simple as one would be inclined to believe from what has been said here tonight.

Dr. Reed's cases have been free from fever and sepsis. I attribute that as much to a lack of vaginal manipulation as I do to his short labor. In the great majority of cases the only intervaginal manipulation would be done with the introduction of the bag, and after that no other examinations

made, and that has some bearing on his lack of morbidity.

I think the work as it is being carried on will impress a great many men with the results, and as Dr. Heaney stated, I would like to see the results from this method in a series of normal cases.

DR. REED (closing): I have been much gratified at the interest that the members of the society and visitors have shown in this paper. It has been, as you can readily understand, a matter of extreme fascination to me to carry out this study. The work as it has gone on from day to day has really made life worth living in a city that is not calculated to stimulate the imagination or the soul.

In regard to the remarks made by Dr. Webster and Dr. Culbertson, I will say that both cover the subject very definitely; it makes little or no difference to babe or mother whether or not the woman is delivered two weeks before the expected time; but it does make a difference if she is delivered two weeks after her expected time both to babe and mother. I would like to emphasize that point because the baby grows with each succeeding week in pregnancy and labor becomes increasingly difficult. Dr. von Winckel has demonstrated thoroughly and completely that point, and I refer you to his paper published in the *Deutsche Klinic* for 1904, for an elaboration of the subject.

I agree with Dr. Webster as to the difficulties we encounter from a rigid cervix. I think I would rather encounter a contracted pelvis any time than these abominable, cartilaginous, fibroid conditions of the cervix, which make the life of the obstetrician so atrociously unpleasant.

Dr. Paddock made use of the term "meddlesome obstetrics." I had expected something like that. I used to hear the term applied to surgery—meddlesome surgery—when somebody opened an appendiceal abscess. I remember it distinctly. The fact of the matter is, are we going to allow midwives to attend to these cases or are we going to control the process from beginning to end ourselves? That is the point. Shall we control labor, or shall we shirk responsibility? I do not mean that this is a method that the general practitioner is going to adopt universally; not at all, but for us who are engaged in this special line of work, let us as men take the responsibility for it ourselves. Dr. Paddock remarked that he could not get his patients to consent to it. I wish you could see our patients at Wesley Hospital. As the patients come back into the ward day after day with the introduction of the bag and the termination of labor in three, four, and five hours relieved of their burden, the waiting women crowd up with, "Doctor, when can I have mine? When are you going to take me? Why cannot I come tomorrow?" Every day we hear such expressions. There is no difficulty if you have control of your patient. I say to my people, "I can shorten labor from four to eight hours. Do you want to do it or shall you let Nature do it?" We do not insist on it. It is a matter for the mothers themselves to choose unless the ward is full. Then we ask them to take the bag or go out and come back.

As to the introduction of the bag, Dr. Paddock and others have manifested a reluctance to do it without an anæsthetic. I would like to say, that my associates at the Wesley Hospital see one bag introduced, and after that they do it themselves without any trouble. My internes will put in the bag without giving the woman an anæsthetic, without any difficulty whatever. Is not that true, Dr. Long?

DR. LONG: Yes, sir.

DR. REED: They introduce the bag without any trouble whatever, month after month, and there is no difficulty connected with the technique. It is a matter that anybody can learn providing he has the mechanical or manual dexterity which enables him to do obstetrics at all and do it right. I have no trouble. The boys at the hospital who are attending this service have put the bag in at nine o'clock, and the woman is delivered at three and at six in the afternoon. Of course, I do not believe in the long duration of these cases. I do not believe in the prolongation of bag-retention, and yet when I think of the old methods that we employed in pathologic cases some years ago, such antiquated and timorous technique for instance as the use of iodoform gauze, which bares with it all the evils of every half hearted measure. The gauze stuffed up into the cervix merely starts absorption at once and when it is left there for twenty-four or thirty-six hours the danger can be imagined; or considering the introduction of the rectal tube which is left forty and fifty hours in the old days. It seems to me that the introduction of the bag which stays only for eight hours in the great majority of cases is pretty good obstetrics in the light of these archaic methods which are still advocated by men who should know better.

As to the use of castor oil and quinine, in many cases it is doubtless a valuable method. If the woman can be delivered with quinine and castor oil, let her be so delivered. The thing is to deliver her at the time we say and make the delivery as painless as possible. That is what we are trying to do. In the olden times frankly this method could not have been used; it would have been impossible. Why? Because in those days when the bag came out the pains sometimes stopped; labor did not go on, and this happens now sometimes. But today we have pituitrin, and it follows in afterward and the labor proceeds and the woman is delivered. The babies do not suffer and the women do not suffer for more than a few hours. We do not intend to secure complete dilatation with the bag; we merely induce labor, and Nature produces complete dilatation and does it quickly after the bag comes out. We have used a No. 5 bag which brings us complete dilatation, but it induces such violent contractions that it is not wise in my opinion to use it unless required.

The technique of the weight is also very important. The weight must be adjusted, and I am free to say that these cases do require an unusual amount of attention but if you start the case in the morning when you are fresh and vigorous, and the case terminates in the afternoon, you have spent all the time on that case that you had to, and it is much pleasanter than spending all night and all day, as we used to do waiting for the activities of a wholly indifferent *Nature*.

I believe what I have said covers all the points, and I thank you gentlemen for your generous discussion.

NITROUS OXIDE ANALGESIA IN LABOR; A STUDY OF 100 CASES

Dr. W. G. Danforth (by invitation) read a paper entitled "Nitrous Oxide Analgesia in Labor; A Study of One Hundred Cases." (See p. 354.)

DISCUSSION

Dr. Carl Henry Davis: The use of nitrous oxid and oxygen in the obstetrical work at the Presbyterian Hospital began about eleven years ago. Dr. Webster first used the nitrous oxide-oxygen anæsthesia in operative obstetrics when ether and chloroform were contra-indicated. Its use was gradually extended to all types of cases, but prior to 1913 it was restricted to private patients and in no case was it used longer than two hours. During the winter of 1913 Drs. Lynch and Heaney experimented with the nitrous oxide-oxygen analgesia using it during the entire painful stage of labor in quite a number of cases. The various members of the staff experimented with the method during the winter of 1914, and after we were all convinced that it is safe, practical, and not too expensive, Dr. Webster reported the results to the Chicago Gynecological Society.

During the past seven months the technique employed has been practically the same, the postpartum care of the patient's has varied very little, and the infants have been on the four hour nursing intervals. For these reasons it has seemed best to study only the cases delivered during this period. In September, I tabulated 104 cases delivered during the previous four and one-half months. The analgesia was administered to all patients who requested it, provided they could pay its cost, and to a few charity cases whose physical condition made an easy labor necessary. There were in this series 44 primiparæ and 15 multiparæ who had the nitrous oxide-oxygen analgesia, and 18 primiparæ and 27 multiparæ who had nothing, or ether for delivery. Since making this study 53 more cases have been discharged from the maternity department and 50 of these had nitrous oxide and oxygen during a part or all of the painful stage of labor, the periods ranging from fifteen minutes to seven hours. There were in this second group 23 primiparæ and 27 multiparæ. The following table shows the comparative findings of the two studies, and is of considerable interest in that the first were more or less selected while the second group of analgesia cases were consecutive.

The statistics recorded in this table speak for themselves and while I must confess that the results are more favorable than any of us had expected, they substantiate all of the claims made for the nitrous oxide-oxygen analgesia, and I believe that within the year these results will be confirmed by obstetricians in all parts of the country.

In administering the nitrous oxid-oxygen analgesia there are several points which deserve special attention. It must be remembered that nitrous oxide anæsthesia cannot be given according to ether standards or rules, and furthermore, that nitrous oxide-oxygen analgesia differs from both. In administering the obstetrical analgesia the patient will never become cyanotic since this can only follow anæsthesia and is the first symptom of asphyxiation. With our present technique there is little chance of anæsthetizing the patient since we determine the minimum number of regular deep inhalations required to produce analgesia and when these are given the valve is closed and the edge of the inhaler is raised sufficiently to permit the breathing of air. As the contractions increase in duration and severity one or more inhalations is added but it is rarely necessary to continue the gas to the end of the contraction. In case the uterus is very irritable and the contractions come on so quickly that the patient feels severe pain before the analgesia can be secured it may be necessary to administer a continuous analgesia, but again there is no danger of anæsthesia or cyanosis if fifteen or 20 per cent of oxygen is added. In a case that Dr. Webster confined recently, using the usual technique we were unable to relieve the suffering, but this was overcome by administering a continuous analgesia for nearly three hours. Thus far I have not had a case in which it was not possible to relieve the suffering of labor by means of the nitrous oxide-oxygen analgesia, and I have used it in all types of cases and all classes of patients. Patients who refused to take anything have been forced to take the gas as a means of securing quiet in the maternity; patients who understand no English or German have been taught to take the analgesia with very little difficulty, and within a few contractions.

The administration of the nitrous oxide-oxygen analgesia, or in fact that of any form of analgesia has required a constant attendance on the patient which is very tiresome and at times quite difficult. The self-administration of chloroform *a la rèine* has long been practiced in certain parts of Europe, and it has seemed that a similar method might be practical with the nitrous oxid. After several conferences with the engineering department of the A. C. Clark Co., they have perfected a release valve which is attached near the inhaler by means of

Statistics from the clinic of Dr. J. Clarence Webster, Presbyterian Hospital, Chicago.	Nitrous Oxide-Oxygen		Analgesia		No Analgesia	
	Series I		Series II — Consecutive Cases		Series I	
	44 Prim.	15 Mult.	23 Prim.	27 Mult.	18 Prim.	27 Mult.
Average during labor	13.5 hours	7.33 hours	11.25 hours	6 hours	17.9 hours	10 hours
Sex of infant	21 male 23 female	7 male 8 female	11 male 12 female	13 male 14 female	13 male 5 female	12 mal 15 female
Average weight at birth	7 pounds 5 ounces	7 pounds 12 ounces	7 pounds 6 ounces	7 pounds 7 ounces	7 pounds	7 pounds 2 ounces
Average loss in weight after birth, first week	7.8 ounces	9.4 ounces	8 ounces	8.63 ounces	7.9 ounces	8.4 ounces
Percentage of weight lost in first week	6.7	7.58	6.8	7.25	7.14	7.37
Voorhees bag	0	0	1	4	0	0
Pituitrin before delivery	4	1	3	1	1	2
Forceps delivery	1 L. O. P. 2 R. O. P.	1 mitral stenosis	1 mitral stenosis 1 no progress 3 hours	1 high R. O. P. 2 deep R. O. T.	2 L. O. A. maternal exhaustion	0
Lacerations						
First degree	23	3	7	2	7	5
Second degree	5	4	6	4	7	2
Third degree	0	0	0	0	0	0
Episiotomies	2	0	3	0	0	0
Maternal deaths	0	0	0	0	0	0
Still-births	0	0	1*	0	0	0
Died first week	0	0	1†	0	2‡	1§
Post-partum hæmorrhage	0	0	0	0	0	1
Failure to secrete milk	0	0	0	0	0	0
Days in hospital after delivery	10.8	11.9	11.7	10.7	12.2	11.1

*Patient admitted to maternity 30 minutes before delivery; had not felt life since labor began. Had N_2O-O less than 20 minutes.
†Died 12 hours after birth. Necropsy showed patent foramen ovale.
‡One, premature 6½ months. One, injury in delivery of the after-coming head in a breech presentation. Necropsy showed rupture of the longitudinal sinus.
§Case of hydramnios with premature delivery at 6 months.

which it is practical for the patient to administer her own analgesia during the greater part if not all of the painful stage of labor. This valve serves a double purpose in that it prevents the mixture of air with the gas in the tube during the intervals between pains. In using the self administration I would suggest that the mixture contain about 5 per cent oxygen, and that the mixing valve need not be changed except in case a different percentage of oxygen is desired. Should the patient not follow instructions and take more than the required number of inhalations she can do no real harm since if she should become anæsthetized her fingers would relax, the inhaler fall away and the spring exhaust valve automatically close.

Nitrous oxide-oxygen analgesia in obstetrics has passed the experimental stage and is now practical in all classes of cases. In the practice of every physician who understands the science of obstetrics it is an absolutely safe and comparatively simple method of eliminating the suffering and shock of labor. When it is used the delivery room is as quiet as any other operating room. However with the analgesia the stage of labor cannot be judged by the nature of the outcry and the obstetrician must carefully watch his patient or she may deliver her baby and not know that it is being born.

DR. J. CLARENCE WEBSTER: I am glad to know that Dr. Danforth has had such interesting results. Similar results are being reported from different parts of the country.

There is one point I would like to bring to the attention of Dr. Danforth, and that is, I hope he will give up the use of ether entirely for forceps delivery. I have not used ether for years, and the gas is thoroughly and absolutely satisfactory for every form of obstetric maneuver. It may be necessary to push it beyond the analgesic stage.

DR. CHARLES B. REED: I congratulate the essayist and the gentlemen who are pushing gas anæsthesia on the success they are achieving, and I would like to add a word of praise for the sincerity with which it is being done. It has happily been applied without the newspaper notoriety which has

unfortunately accompanied twilight sleep. There is one thing, however, which twilight sleep has done, and that is, it has compelled the profession generally to recognize the fact that woman has pain during her labor. It was in following out this idea I first took up the bag, reasoning that if a woman must have pain, why not shorten it as much as possible. Then came twilight sleep and the gas which in my opinion do not conflict. Twilight sleep we are working out as sincerely as we can at Wesley Hospital, and, as I mentioned, it is a first and second stage anæsthetic; whereas gas, as we use it, can be employed to best advantage in second stage cases. If a woman is not anæsthetized previous to her second stage or comes in at the time when labor will terminate within two hours, twilight sleep would be definitely contra-indicated, and the gas just as definitely indicated, and it is a desirable addition to the armamentarium of the obstetrician.

I would like to ask Dr. Davis who spoke about post-partum care if in his opinion early rising of the woman does in his experience bring too much strain upon the ligaments; if the enlarged uterus, still congested from labor, does not pull too strongly upon the ligaments and possibly develop a weakness.

As regards the shortness of the labor, I would like to say in my opinion it is highly desirable to get the labor as closely and as rationally as possible down to the quickest minimum.

I congratulate both of the gentlemen on their work with the gas.

DR. CARL DAVIS: That question was one which worried us for a long time at the Presbyterian Hospital and caused us to take up the early rising, as it were, rather carefully. Dr. Heaney was in Europe at the time and came back rather enthusiastic about it while the rest of us were skeptical. About a year and a half ago, however, I became interested in a subject which is somewhat foreign to this, but which did bring to a focus the question of early rising.

In looking up the statistics on thrombosis and embolism, I found that the general statistics in the German clinic showed one case of fatal embolism as an average in nine hundred cases; whereas in two of the clinics, where they put the patients up on the second and third day, in 5,000 cases there was not a single instance of thrombosis or embolism. That was very suggestive, and so we started in using more than we had done previously the back-rest on the second day, still keeping the patients in bed longer than a period of eight to ten days. Then we studied the situation from another angle and decided it was easier for the patient to sit in a chair beside the bed than to sit in a rather uncomfortable position with the makeshift of a back-rest; and so our patients are not allowed to walk, but are helped into a chair and sit on a pillow at the side of the bed. That gives drainage. It does not cause any extra strain on the ligaments, and thus far we have not seen a case in which there has been any harmful results occur from this procedure, and at the end of ten or eleven days a rectal examination is made before the patient leaves the hospital which shows that the uterus is down about to the point we expect at the end of two weeks. This gives us better drainage, and I do believe it is a real advantage.

DR. DANFORTH (closing): I was much interested in seeing Dr. Davis' table of results following analgesia; it corresponds with those who have been accustomed to using this method since we started the use of analgesia.

This little apparatus with a small valve for the self-administration of the gas I have not seen before. I knew it had been brought out. It appeals to me as being an excellent device. I shall certainly try it, and hope later to have some experience along that line to report.

I have been frequently asked by those who are not accustomed to using gas as to the cost of gas-analgesia. I referred in my paper to the fact that one small tank would suffice for a number of hours. We find, as a routine, taking all cases as they come, ward cases and all, the expense is between two and three dollars per hour, so that making a charge at that figure you can pay all expenses connected with the administration of the gas, such as the buying of the gas, and the salary of some one to give it. If the head-nurse of the obstetrical department could be trained to give it efficiently and constantly, the gas could be given for less than that.

Since the presentation of a paper by Dr. Heaney on this subject, I have had occasion to give the gas during the manual rotation of an occipitoposterior without any complaint of pain on part of the patient.